Form PTO-1390	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER P21265
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/868934
INTERNATIONAL APPLICATION NO. PCT/JP00/00285	INTERNATIONAL FILING DATE 21 January 2000	PRIORITY DATE CLAIMED 22 January 1999

TITLE OF INVENTION

DICARBA-closo-DODECABORANE DERIVATIVES

APPLICANT(S) FOR DO/EO/US

Yasuyuki ENDO

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. _X_ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ___ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. _X_ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. _X_ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. _X_ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. _X_ is attached hereto (required only if not communicated by the International Bureau).
   b. _X_ has been communicated by the International Bureau.
   c. ___ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. _X_ An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2)).
7. ___ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ___ are attached hereto (required only if not communicated by the International Bureau).
   b. ___ have been communicated by the International Bureau.
   c. ___ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ___ have not been made and will not be made.
8. ___ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3))
9. _X_ An oath or declaration of the inventor(s) (35 U.S.C. .371(c)(4)).
   "Unexecuted"
10. ___ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (U.S.C. 371(c)(5)).

It ms 11 to 16 below concern other document(s) or information included:

11. Assignee: INSTITUTE OF MEDICINAL MOLECULAR DESIGN, Inc. of Tokyo, JAPAN
12. ___ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13. ___ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14. ___ A FIRST preliminary amendment.
    ___ A SECOND or SUBSEQUENT preliminary amendment.
15. ___ A substitute specification.
16. ___ A change of power of attorney and/or address letter.
17. ___ Figure of Drawing to be published_____
18. _X_ Other items or information:
    Cover Sheet and International Application as published(in Japanese).
    PCT/RO/101-PCT Request(in Japanese).
    PCT/IPEA/408(in Japanese).
    PCT/IPEA/409.
    PCT/IB/301.
    PCT/IB/304.
    PCT/IB/306.
    PCT/IB/308.
    PCT/IB/332.
    PCT/IB/338.
    PCT/ISA/210(in Japanese and English).
    Cover Letter under 35 USC 371 and 1.495.
    Claim of Priority.

APPLICATION NO. (If known, see 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/868934	PCT/JP00/00285	P21265

19. X The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search report has been prepared by the EPO or JPO. . . . . $ 860.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482). . . . . $ 690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO(37 CFR 1.445(a)(2). . . . . $ 710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO. $1,000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4). . . . . $ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ___ 20 ___ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	RATE		
Total Claims	7 - 20 =	0	X $18.00	$0.00	
Independent Claims	3 - 3 =	0	X $80.00	$0.00	
Multiple dependent claim(s) (if applicable)			+ $270.00	$0.00	
			TOTAL OF ABOVE CALCULATIONS =	$860.00	
___ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				$	
			SUBTOTAL =	$860.00	
Processing fee of $130.00 for furnishing the English translation later than ___ 20 ___ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +					
Extension of Time fee in the amount of $					
			TOTAL NATIONAL FEE =	$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +					
			TOTAL FEES ENCLOSED =	$860.00	
			Amount to be refunded	$	
			Charged	$	

a. X A check in the amount of $860.00 to cover the above fees is enclosed.

b. ___ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees.

c. X The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-0089.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO **CUSTOMER NO. 7055**
AT THE PRESENT ADDRESS OF:
Bruce H. Bernstein
GREENBLUM & BERNSTEIN, P.L.C.
1941 Roland Clarke Place
Reston, VA 20191
(703) 716-1191

Leslie J. Pigerman Reg. No.
SIGNATURE
Bruce H. Bernstein 33,329
NAME

29,027
REGISTRATION NUMBER

21265.P04

#3

77 Rec'd PCT/PTO 04 OCT 2001

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   "Executed"
10. An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (U.S.C. 371(c)(5)).

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    ___ A SECOND or SUBSEQUENT preliminary amendment.
15. ___ A substitute specification.
16. ___ A change of power of attorney and/or address letter.
17. ___ Figure of Drawing to be published_____
18. X Other items or information:
    Cover Letter.
    Copies of forms PCT/DO/EO/905 and PCT/DO/EO/917.

10/09/2001 UEDUVIJE 00000083 09868934

01 FC:154 130.00 OP

SPECIFICATION

DICARBA-*closo*-DODECABORANE DERIVATIVES

Technical Field

The present invention relates to a novel dicarba-*closo*-dodecaborane derivative. The present invention also relates to a medicament comprising said dicarba-*closo*-dodecaborane derivative as an active ingredient.

Background Art

Dicarba-*closo*-dodecaborane (hereinafter abbreviated as "carborane" in the specification) is an icosahedral cluster containing two carbon atoms and ten boron atoms in which both atoms are hexacordinated. In caboranes, depending on the position of the carbon atoms in the cluster, 3 kinds of isomers exist, i.e., 1,2-dicarba-*closo*-dodecarobane (*ortho*-carborane), 1,7- dicarba-*closo*-dodecaborane (*meta*-carborane), and 1,12-dicarba-*closo*-dodeca borane (*para*-carborane). These structures are unique among boron compounds, namely they are characterized to have very high thermal stability and hydrophobicity comparable to hydrocarbons.

A major utility of compounds composed of a carborane so far has been an application to ^{10}Boron-Neutron Capture Therapy (BNCT). ^{10}Boron-Neutron Capture Therapy has been developed as a therapy mainly to glioma and melanoma. When ^{10}B atom is irradiated with thermal neutron (slow neutron), an α ray with 2.4 MeV energy is emitted and the atom is decomposed to ^{7}Li and ^{4}He. The range of α ray is about 10 μ m which corresponds to a diameter of cells. Therefore, effects are expected that only cells in which ^{10}B atoms are uptaken are destroyed and other cells are not damaged. For the development of BNCT, it is important how to have cancer cells selectively uptake ^{10}B atoms in a concentration capable of destroying cells with neutron radiation. For that purpose, *ortho*-carborane skeleton has been utilized which has low toxicity and a high ^{10}B atom content, and is easy to be synthesized. Moreover, nucleic acid precursors, amino acids, and porphyrins which contain *ortho*-carboranes have been synthesized and subjected to evaluation.

Disclosure of the Invention

Studies on carborane compounds have been focused solely on creation of compounds suitable for BNCT, and therefore, for a purpose of introducing carboranes into cells, designs have been made in which carborane skeletons are attached to compounds with biological roles. However, the conventional studies are far from drug designs which utilizes properties of the carboranes per se for molecular recognition in vivo. An object of the present invention is to provide novel bioactive substances which utilize a carborane as a hydrophobic pharmacophore for a partial structure of a medicament on the basis of understanding of physical and chemical properties of carboranes.

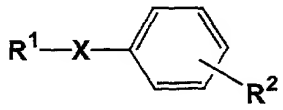
Generally, hydrogen bonding and shape of molecule as well as hydrophobic interaction contribute to stabilization of a ligand-receptor complex. Accordingly, it is considered that introduction of a carborane as a hydrophobic moiety may increase the stability of a ligand-receptor complex and enhance a desirable biological activity. Carborane-containing nuclear receptor ligands provided by the present invention are promising compounds for application to BNCT from a viewpoint of targeting to cancer cells. As agents acting on nuclear receptors, they are expected to have pharmacodynamics different from that of conventional drugs while exhibiting superior activities.

An object of the present invention is to provide a bioactive compound having a carborane skeleton as a pharmacophore. More specifically, the object is to provide a novel compound which has a superior bioactivity and is useful as a regulating agent on a nuclear receptor with reduced cytotoxicity. Another object of the present invention is to provide a medicament comprising said compound as an active ingredient which is useful as an agent for differentiation-inducing therapy for leukemia and an estrogenic agent.

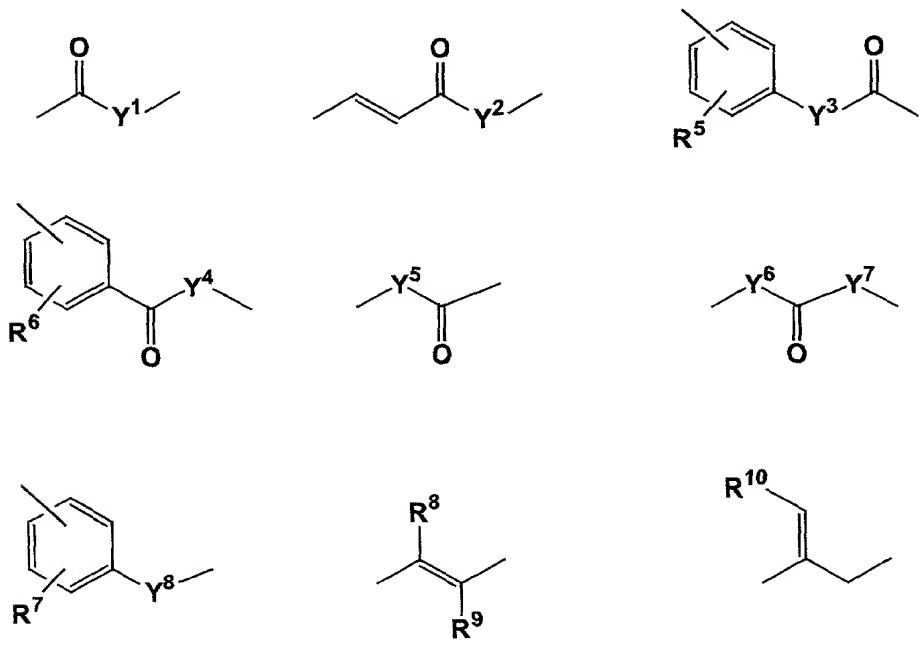
As a result of zealous endeavor of the inventors of the present invention to solve the foregoing objects, the inventors found that a compounds having a dicarba-*closo*-dodecaborane structure represented by the following general formula (I) has superior activity as a ligand of a nuclear receptor such as the retinoic acid receptor and exhibits a superior therapeutic effect as a differentiation-inducing agent for the treatment of leukemia. The present invention was achieved on the basis of these

findings.

The present invention thus provides a medicament which comprises as an active ingredient a compound or a physiologically acceptable salt thereof represented by the following general formula (I) :



wherein R_1 represents a dicarba-*closo*-dodecaboran-yl group which may have one or more substituents selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a mono or di-lower alkylcarbamoyl-substitute alkyl group, a lower alkanoyl group, an aryl group which may be substituted, and a lower aralkyl group which may be substituted; R^2 represents carboxyl group, a lower alkoxycarbonyl group, or hydroxyl group; X represents a single bond, or a linking group selected from the group consisting of groups represented by the following formulas:



[wherein Y^1, Y^2, Y^3, Y^4 Y^5, Y^6, and Y^7 independently represent oxygen atom or -N(R^3)- (wherein R^3 represents hydrogen atom or a lower alkyl group); Y^8 represents oxygen atom, -N(R^4)- (wherein R^4 represents hydrogen atom or a lower alkyl group), -CO-, -CH_2-, or -C(=CH_2)-; R^5, R^6, and R^7 independently represent hydrogen atom or one or more substituents on the phenyl group; R^8 represents a lower alkyl group or an aryl group which may be substituted; R^9 represents a lower alkyl group; and R^{10} represents an aryl group which may be substituted].

According to preferred embodiments of the aforementioned invention, provided are:

(1) a medicament comprising as an active ingredient the compound or a physiologically acceptable salt thereof represented by the aforementioned formula (I) wherein R^1 is a dicarba-*closo*-dodecaboran-yl group which may have a lower alkyl group, R^2 is carboxyl group or a lower alkoxycarbonyl group, and X is the aforementioned linking group; and

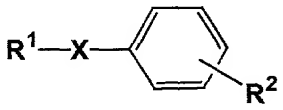
(2) a medicament comprising as an active ingredient the compound or a physiologically acceptable salt thereof represented by the aforementioned formula (I) wherein R^1 represents a dicarba-*closo*-dodecaboran-yl group which may have a substituent selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a lower alkanoyl group, phenyl group which may be substituted, hydroxyphenyl group, and a lower alkoxyphenyl group, R^2 represents hydroxyl group, and X is a single bond.

The compound represented by the aforementioned formula (I) or a physiologically acceptable salt thereof can act as a ligand of a nuclear receptor. Therefore, the medicament is useful as an agent as a retinoid or an estrogenic agent, and also useful for therapeutic and/or prophylactic treatment of cancer, rheumatism, arteriosclerosis, diabetes, rejection reaction in case of an organ transplantation, and graft versus host disease. Particularly, the aforementioned medicament comprising the compound defined by (1) or a physiologically acceptable salt thereof can be used, for example, for therapeutic treatment of leukemia as an agent having retinoid action. The aforementioned medicament comprising the compound defined by (2) or a physiologically acceptable salt thereof is useful as an estrogenic agent, for example, for

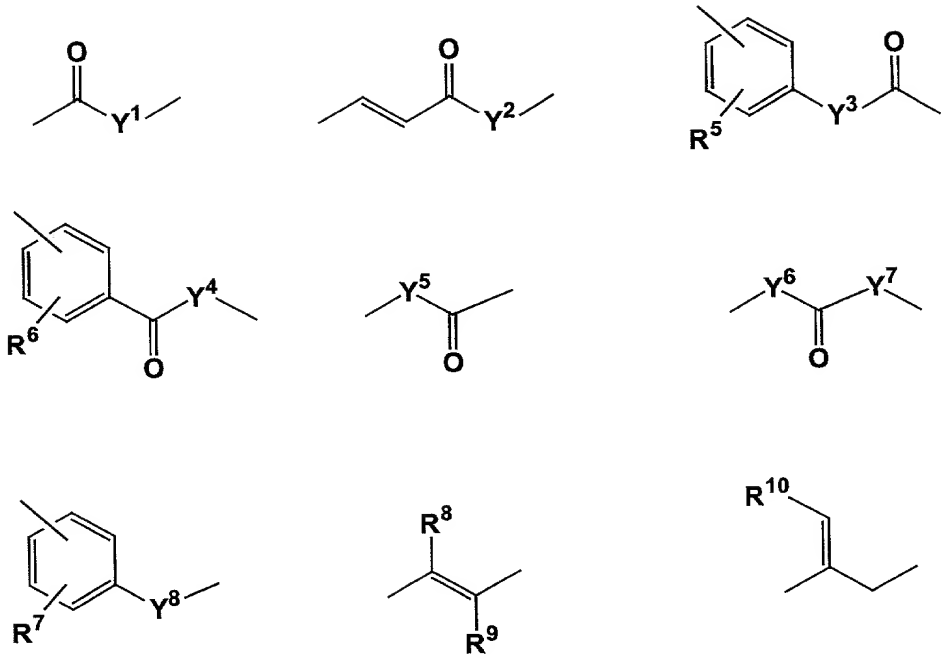
the prophylactic and/or therapeutic treatment of female hormone balance adjustment, menstrual disorders, osteoporosis, or cancer.

From another aspect, the present invention provides a use of the compound represented by the above formula (I) or a salt thereof for the manufacture of the aforementioned medicament; a method for therapeutic treatment of leukemia which comprises the step of administering to a patient a therapeutically effective amount of the compound represented by the aforementioned formula (I) or a physiologically acceptable salt thereof, preferably the compounds defined by the aforementioned (1) or a physiologically acceptable salt thereof; and a method for therapeutic and/or prophylactic treatment of a solid cancer or a serious dermatosis which comprises the step of administering to a patient a therapeutically effective amount of the compound represented by the aforementioned formula (I) or a physiologically acceptable salt thereof, preferably the compounds defined by the aforementioned (1) or a physiologically acceptable salt thereof.

From further aspect, the present invention provides, as a novel substance, the compound or a salt thereof represented by the following formula (I):



wherein R^1 represents dicarba-*closo*-dodecaboran-yl group which may have one or more substituents selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a mono or di-lower alkyl carbamoyl-substituted alkyl group, a lower alkanoyl group, an aryl group which may be substituted, and a lower aralkyl group which may be substituted; R^2 represents carboxyl group, a lower alkoxycarbonyl group, or hydroxyl group; X represents a single bond or a linking group selected from the group consisting of the groups represented by the following formulas;

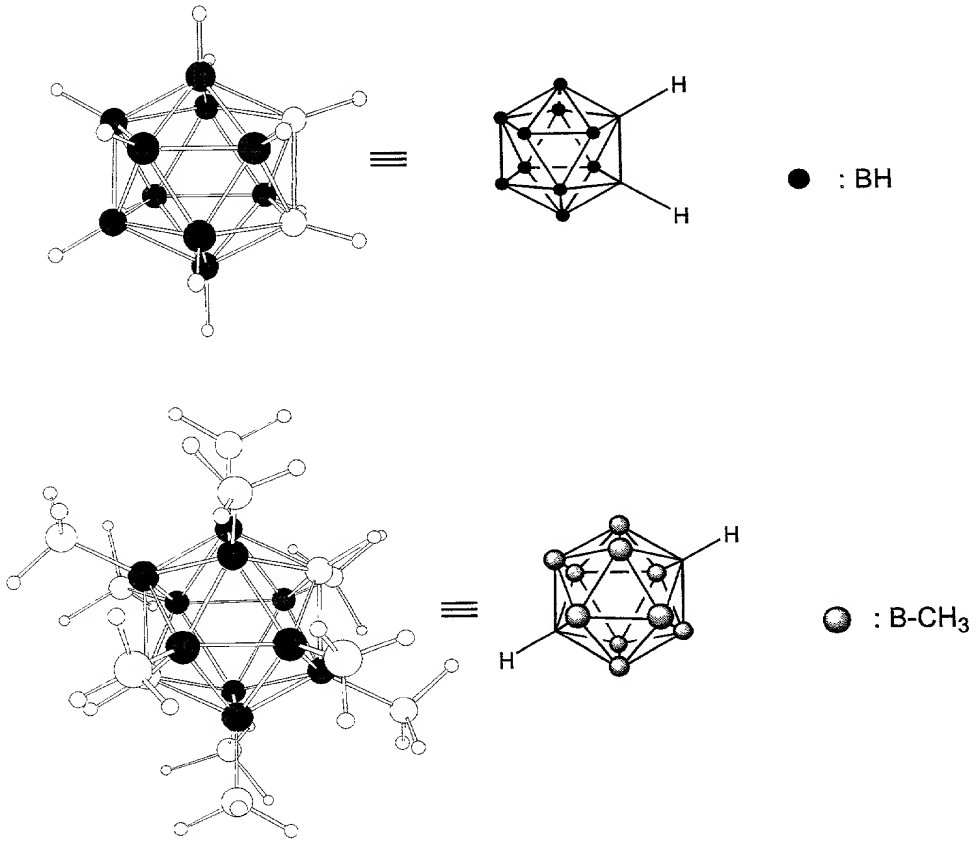


[wherein, Y^1, Y^2, Y^3, Y^4, Y^5, Y^6 and Y^7 independently represent oxygen atom or -N(R^3) - (wherein R^3 represents hydrogen atom or a lower alkyl group); Y^8 represents oxygen atom, -N(R^4)- (wherein R^4 represents hydrogen atom or a lower alkyl group), -CO-, -CH_2-, or -C(=CH_2)-; R^5, R^6, and R^7 independently represent hydrogen atom or one or more substituents on the phenyl group; R^8 represents a lower alkyl group or an aryl group which may be substituted; R^9 represents a lower alkyl group; and R^{10} represents an aryl group which may be substituted], provided, when X is a single bond, the compound wherein R^1 is a non-substituted dicarba-*closo*-dodecaboran-yl group and R^2 is a hydroxyl group, and the compound wherein R^1 is a dicarba-*closo*-dodecaboran-yl group substituted with p-hydroxyphenyl group and R^2 is a hydroxyl group are excluded.

Best Mode for Carrying Out the Invention

1,2-Dicarba-*closo*-dodecaborane (*ortho*-carborane) is a compound shown on the upper part of the following formula. The compound has ten boron atoms expressed as "B" in the formula each having a hydrogen atom and two carbon atoms expressed as "C" in the formula each having a hydrogen atom. 1,2-Dicarba-*closo*-dodecaboran-1-yl group corresponds to a residual group formed by eliminating a hydrogen atom on one

carbon atom in the carborane ring of the formula. As dicarba-*closo*-dodecaboranes, 1,7-dicarba-*closo*-dodecaboranes (*meta*-carborane) and 1,12-dicarba-*closo*-dodecaborane (*para*-carborane) are also known. These can form 1,7-dicarba-*closo*-dodecaboran-1-yl group and 1,12-dicarba-*closo*-dodecaboran-1-yl group similarly to the *ortho*-carborane. The term "dicarba-*closo*-dodecaboran-yl group" used herein encompasses residues of the three isomers of dicarba-*closo*-dodecaboranes. One carbon atom among the two carbon atoms constituting dicarba-*closo*-dodecaboran-1-yl group, which does not participate in the formation of the residue, and ten boron atoms can have a substituent independently. As an example, the lower part of the following formula indicates 1,12-dicarba-*closo*-dodecaborane (*para*-carborane) with methyl groups substituting on all of the ten boron atoms.



The medicament of the present invention are characterized to have a dicarba-*closo*-dodecaboran-yl group as a hydrophobic pharmacophore. A biopolymer molecule represented by a receptor, hereafter simply referred to as "receptor", has a

characteristic structure as a partial structure which recognizes a drug, thereby forms stable bonds through spatial interaction with the drug and exhibits its bioaction. Plural functional groups or group composed thereof involved in the interaction are called "pharmacophore." A hydrophobic part of a drug stabilizes the bonds through hydrophobic interaction with the binding site of a receptor and has a significant role in recognition of a drug structure by a receptor.

The term "hydrophobic pharmacophore" in the compound of the present invention means a partial structure of a pharmaceutical compound and a structure which, as a hydrophobic moiety, has contribution or is expected to have contribution to bond stabilization with a receptor. The compound of the present invention has a dicarba-*closo*-dodecaboran-yl group as a hydrophobic pharmacophore and can be used as a medicament. Particularly, said compound can act as an agonist or an antagonist to a nuclear receptor to which a nuclear receptor ligand such as retinoid, estrogen, androgen or thyroid binds. Some compounds having a dicarba-*closo*-dodecaboran-yl group have been studied for application to BNCT. However, use of a dicarba-*closo*-dodecaboran-yl group as a hydrophobic pharmacophore, for a purpose of achieving binding stability with a receptor and enhancing bioactivity based on the binding stability, has not been reported.

In the specification, the lower alkyl or a lower alkyl moiety of a functional group that contains the lower alkyl moiety (e.g., the lower alkoxycarbonyl group, the lower alkenyl group, the lower hydroxyalkyl group, the lower alkanoyl group, the lower aralkyl group and the like) may be linear, branched, cyclic, or a combination thereof, and the number of carbon atom is from 1 to 6, preferably from 1 to 4. As the lower alkyl group, for example, methyl group, ethyl group, n-propyl group, isopropyl group, n-butyl group, sec-butyl group, isobutyl group, tert-butyl group can be used. As the lower alkenyl group, those having 1 to 6 carbon atoms can be used. The number of double bonds contained in the lower alkenyl group is not limited, and the number may generally be one to three, preferably one.

Substituents which can be present on a dicarba-*closo*-dodecaboran-yl group will be specifically explained. Methyl group and the like is preferred as the lower alkyl group. Examples of the lower alkoxy carbonyl group include methoxycarbonyl group, ethoxy carbonyl group and the like. The amino group may have one or two

substituents, for example, a lower alkyl group and a lower alkanoyl group. When the amino group has two alkyl groups, they may bind to each other to form a ring. Examples of the lower hydroxyalkyl group include hydroxymethyl group, 2-hydroxyethyl group, 1-hydroxyethyl group, 3-hydroxypropyl group and the like. Examples of the lower alkanoyl group include acetyl group, propanoyl group and the like.

The number of carbon atoms of the alkyl group substituted with mono or di lower alkyl-substituted carbamoyl group is from 1 to 12, preferably about from 8 to 10, and two alkyl groups may bind to each other to form a ring. Phenyl group is preferable as the aryl group, and benzyl group is preferred as the aralkyl group. When the aryl group or the aralkyl group is substituted, the kind and the number of the substituents are not limited. For example, a lower alkyl group, a halogen atom, hydroxyl group, a lower alkoxy group and the like may be used as a substituent on the ring. A mono or di-lower alkyl-substituted amino group, or a cyclic amino group (e.g., pyrrolidinyl group, piperidinyl group and the like) may be a substituent on the lower alkoxy group on the ring of the aryl group or the aralkyl group. An example thereof includes 2-(N, N-dimethylamino) ethoxy group. The positions of substituents on the ring of the aryl group or the aralkyl group are not limited, and substituents may be in any of *ortho*, *meta*, or *para* position.

When the dicarba-*closo*-dodecaboran-yl group is substituted, the position of each substituent is not particularly limited. Some of or all of the carbon atoms and/or the boron atoms of the carborane ring may be substituted. For example, a substituent selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxy alkyl group, a mono or di-lower-alkylcarbamoyl substituted alkyl group, a lower alkanoyl group, an aryl group which may be substituted and a lower aralkyl group which may be substituted may preferably be present on the carbon atom(s) constituting the carborane ring. Furthermore, some or all of the boron atoms constituting the carborane ring may be substituted with, for example, an alkyl group or the like. Preferred examples include a carborane ring in which all of the boron atoms are alkylated, and a carborane ring in which only carbon atoms are substituted.

As the lower alkoxycarbonyl group represented by R^2, for example, ethoxy

carbonyl group, methoxy carbonyl group and the like are preferred. R^2 may substitute in any position of the benzene ring, and preferably substitute in the *para* position. Y^1, Y^2, Y^3, Y^4, Y^5, Y^6 and Y^7 may preferred be a group represented by -N(R^3)-, and as the lower alkyl group represented by R^3, the alkyl group specifically explained above can be suitably used. R^3 is preferably hydrogen atom or methyl group. When Y^8 is a group represented by -N(R^4)-, R^4 is preferably hydrogen atom or methyl group. When R^5, R^6 and R^7 are substituents on the phenyl group, the kind, number, and position of the substituents are not particularly limited. Examples of the substituent on the phenyl group include, for example, a lower alkyl group, a lower alkoxy group, a lower alkoxycarbonyl group, a halogen atom, carboxyl group, amino group, an alkanoyl group, an aralkyl group, hydroxyl group, however, the substituents are not limited to these examples.

R^5, R^6 and R^7 are preferably hydrogen atoms. When Y^8 is -N(R^4)- (R^4 represents a lower alkyl group, preferably methyl group), R^7 is preferably a lower alkyl group, for example, methyl group. As R^8, ethyl group or phenyl group having a substituent in the *para* position is preferred. When the phenyl group is substituted, an example of the substituent includes a lower alkoxy group substituted with mono or di-lower alkyl amino group where the two alkyl groups may bind to each other to form a ring, more specifically 2-(N,N-dimethylamino)ethoxy group. Ethyl group is preferred as R^9. As R^{10}, phenyl group having a substituent in the *para* position is preferred. An example of the substituent includes mono or di-lower alkylamino group where the two alkyl groups may bind to each other to form a ring, more specifically pyrrolidinomethyl group. When R^1 binds to the phenyl group in X, the binding position is not limited. Preferably, R^1 binds to the phenyl group in the *meta* or *para* position relative to the nitrogen atom or the carbonyl group present in X. When X is a single bond, R^1 binds directly to the phenyl group substituted with R^2. In such compounds, R^2 is preferably hydroxyl group.

More specifically, a preferred embodiment of the present invention includes (1) a compound of formula (I) wherein R^1 is dicarba-*closo*-dodecaboran-yl group which may have a lower alkyl group, R^2 is carboxyl group or a lower alkoxycarbonyl group, and X is the aforementioned linking group. In the aforementioned compound, each of Y^1, Y^2, Y^3, Y^4, Y^5, Y^6, and Y^7 is preferably a group represented by -N(R^3)-, and R^3 is preferably

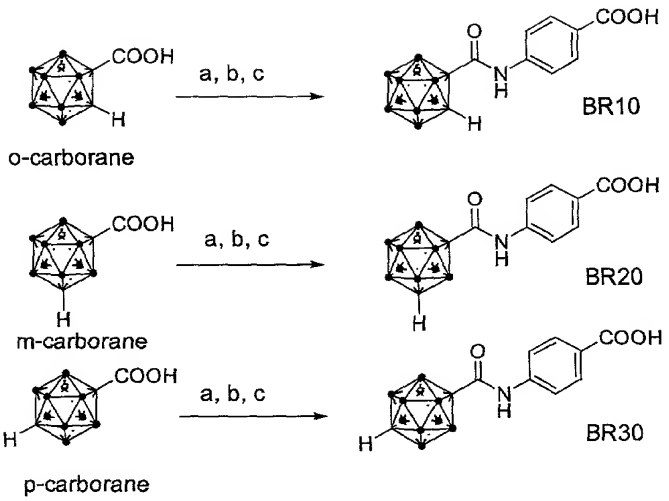
hydrogen atom. Each of R^4, R^5 and R^6 is preferably hydrogen atom. When Y^5 is -N(R^3)- (wherein R^3 is a lower alkyl group, preferably methyl group), R^6 is preferably a lower alkyl group, for example, methyl group.

Another preferred compound includes (2) a compounds of formula (I) wherein R^1 is dicarba-*closo*-dodecaboran-yl group which may have one or more substituents selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a lower alkanoyl group, phenyl group which may be substituted, hydroxyphenyl group, and a lower alkoxyphenyl group, R^2 is a hydroxyl group, and X is a single bond.

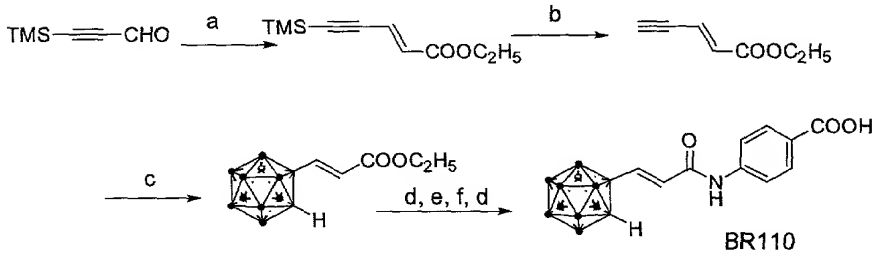
The compound represented by formula (I) may have one or more asymmetric carbon atoms. Any stereoisomers based on the asymmetric carbon atom(s) such as optically active isomers and diastereo isomers, any mixture of the stereo isomers, racemates and the like fall within the scope of the present invention. Furthermore, the compound represented by formula (I) may exist as an acid addition salt or a base addition salt, which also falling within the scope of the present invention. Examples of the acid addition salt include, for example, a mineral acid salt such as hydrochloride, sulfate, and nitrate, and an organic acid salt such as p-toluene sulfonate and maleate. Examples of the base addition salt include, for example, a metal salt such as sodium salt, potassium salt, and calcium salt, ammonium salt, and an organic amine salt such as triethylamine salt. In addition, an amino acid salt such as glycine salt as well as an internal salt (a zwitterion) fall within the scope of the present invention. Moreover, the compound or a salt thereof according to the present invention may form a hydrate or a solvate, and any of these substances fall within the scope of the present invention.

Preparations of typical compounds encompassed within formula (I) are shown in the following schemes. In addition, preparations of these compounds are also described in detail and specifically in the examples of the specification. Those ordinary skilled in the art can prepare any compounds falling within the scope of general formula (I) by referring to the preparations described in the following scheme and specific explanation in the examples, appropriately choosing starting materials, reaction conditions, reagents and the like, and optionally applying modifications or alterations thereto. In the formula (I), compounds wherein X is a single bond, R^1 is

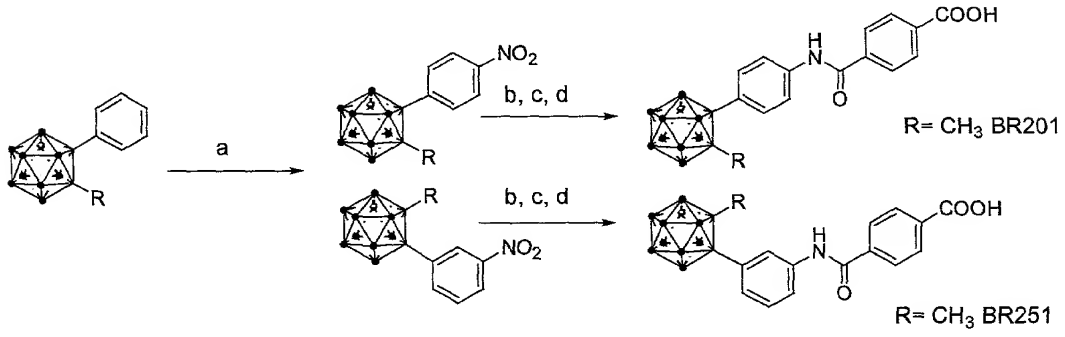
unsubstituted dicarba-*closo*-dodecaboran-yl group, and R^2 is a hydroxyl group (the compounds indicated as BE100, 200, and 300 in the following schemes ; J. Chem. Soc. Dalton Trans., pp.401-411, 1998; Zh. Obshch. Khim., 41, pp.1516-20, 1971) ; and compound wherein X is a single bond, R^1 is 12-(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaboran-yl group, and R^2 is a hydroxyl group (the compound indicated as BE160 ; J. Chem. Soc. Dalton Trans., pp.401-411, 1998) can be prepared by the methods described in the literature.



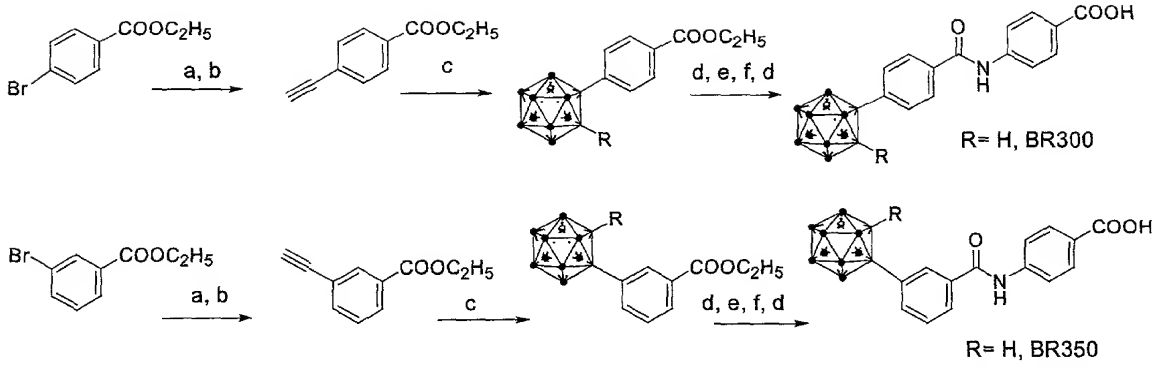
a) $(COCl)_2$, DMF/ CH_2Cl_2; b) methyl 4-aminobenzoate, DMAP/ CH_2Cl_2; c) KOH/ H_2O-THF



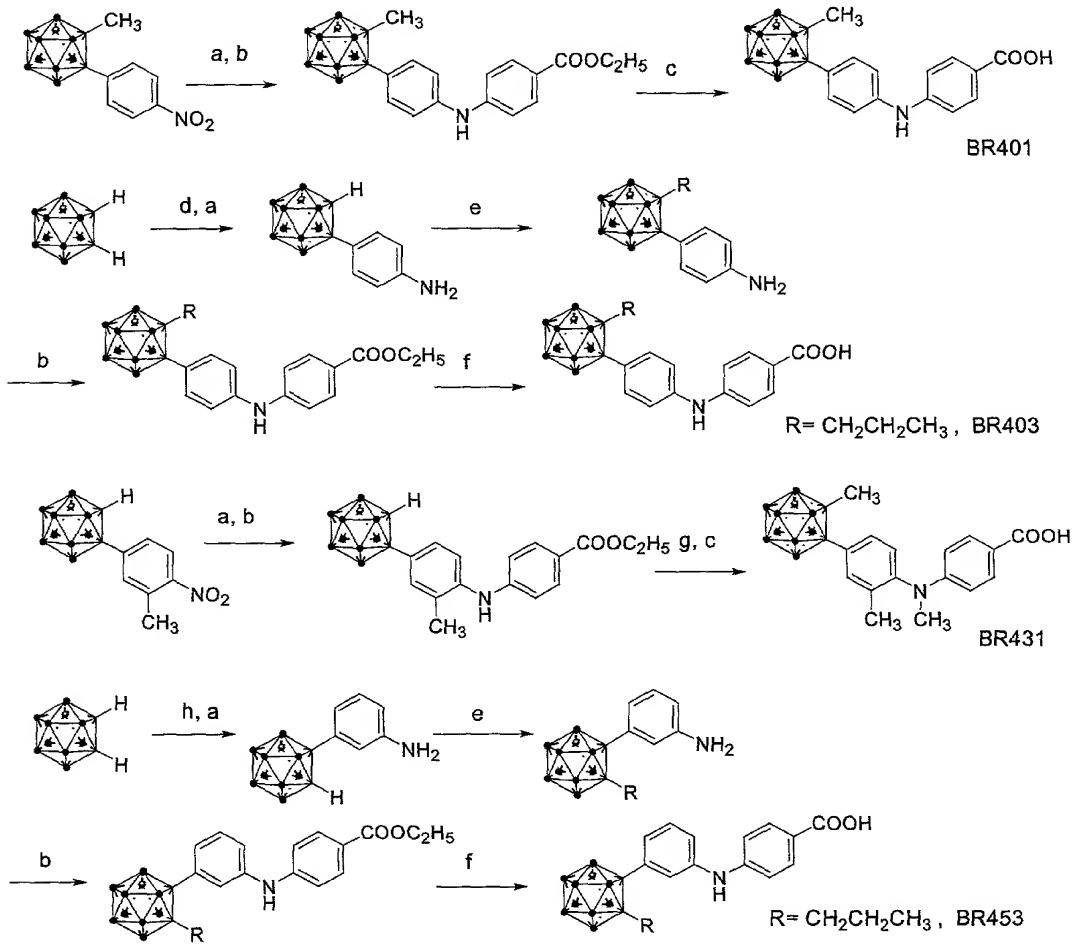
a) $(EtO)_2POCH_2COOEt$, NaH/ THF; b) K_2CO_3/ EtOH; c) cecaborane (14) / CH_3CN-C_6H_6;
d) KOH/ H_2O-THF; e) (COCl)2, DMF (cat)/ CH_2Cl_2; f) methyl 4-aminobenzoate/ pyridine



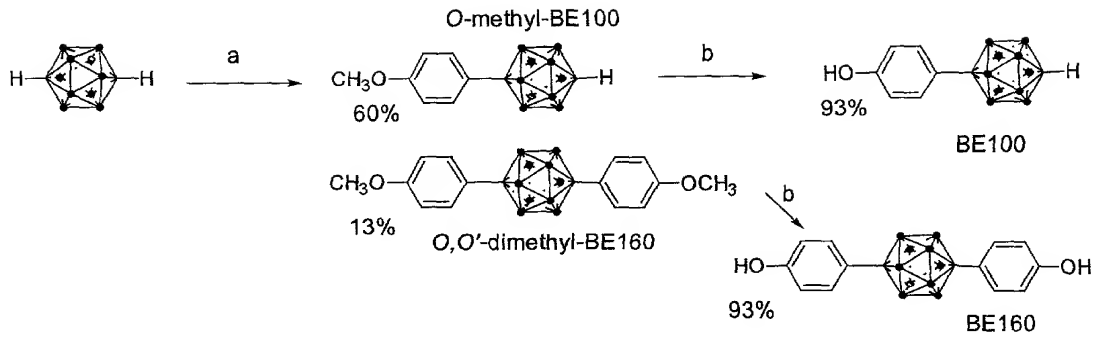
a) HNO_3, H_2SO_4/ CH_2Cl_2; b) H_2, Pd-C/ EtOH; c) terephtalic acid monomethyl ester chloride/ pyridine;
d) KOH/ H_2O-THF



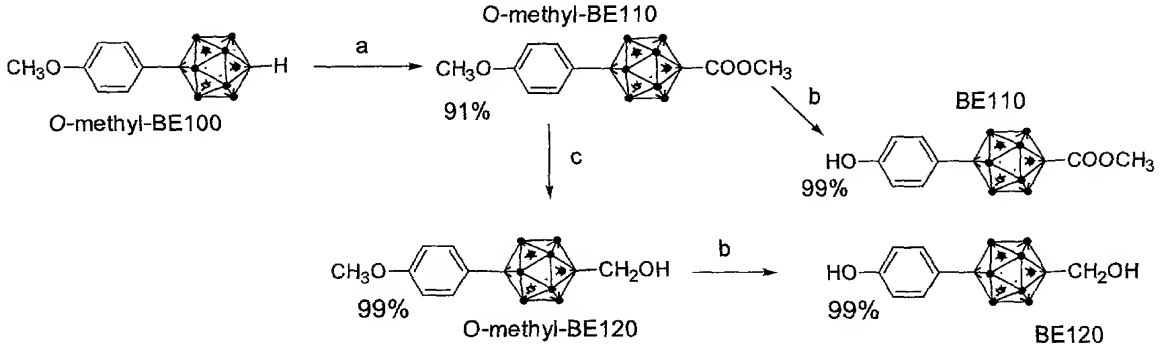
a) ethynyltrimehylsilane, $(PPh_3)_2PdCl_2$, CuI, iPrNH. THF; b) K_2CO_3/ EtOH; c) decaborane (14)/ CH_3CN-C_6H_6; d) KOH/ H_2O-THF; e) (COCl)2, DMF (cat)/ CH_2Cl_2; f) methyl 4-aminobenzoate/ pyridine



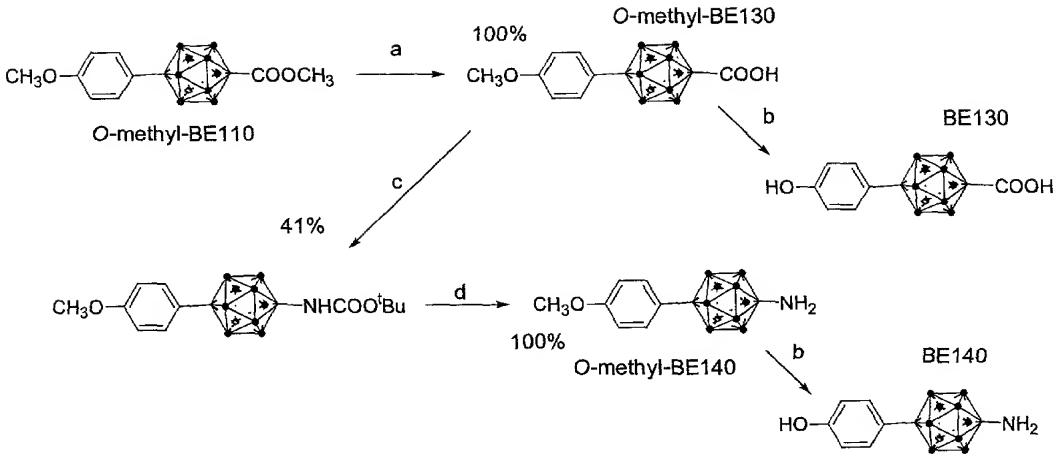
a) H_2, Pd-C/ EtOH; c) ethyl p-iodobenzoate, Cs_2CO_3, $Pd_2(dba)_3$, BINAP/ toluene; c) KOH/ H_2O-THF; d) 1)*n*-BuLi, CuCl/ DME, 2) 4-nitroiodobenzene/ pyridine; e) NaH, R-I/ DMF; f) ; g) NaH, CH_3I/ DMF; h) 1)*n*-BuLi, CuCl/ DME, 2) 3-nitroiodobenzene/ pyridine



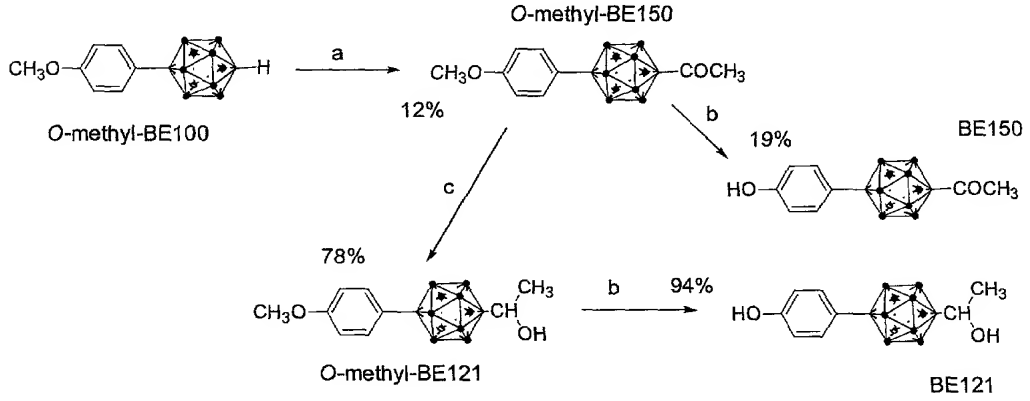
a) 1) n-BuLi, CuCl/DME 2) p-iodoanisole/ pyridine, reflux b) BBr_3/ CH_2Cl_2



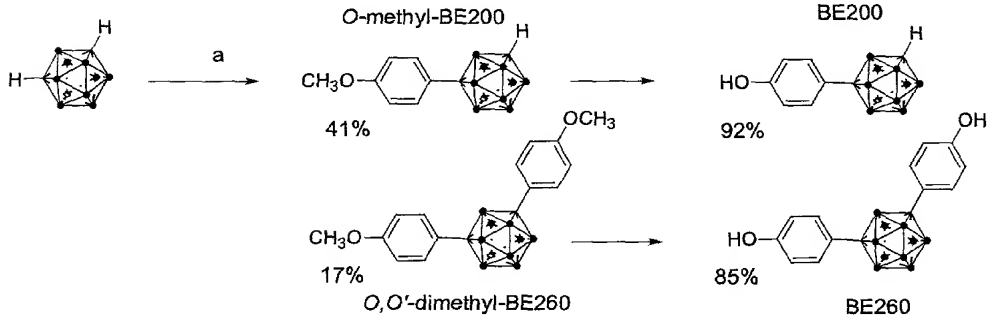
a) 1) n-BuLi/ benzene-Et_2O 2) $ClCOOCH_3$ b) BBr_3/ CH_2Cl_2 c) $LiAlH_4$/ THF



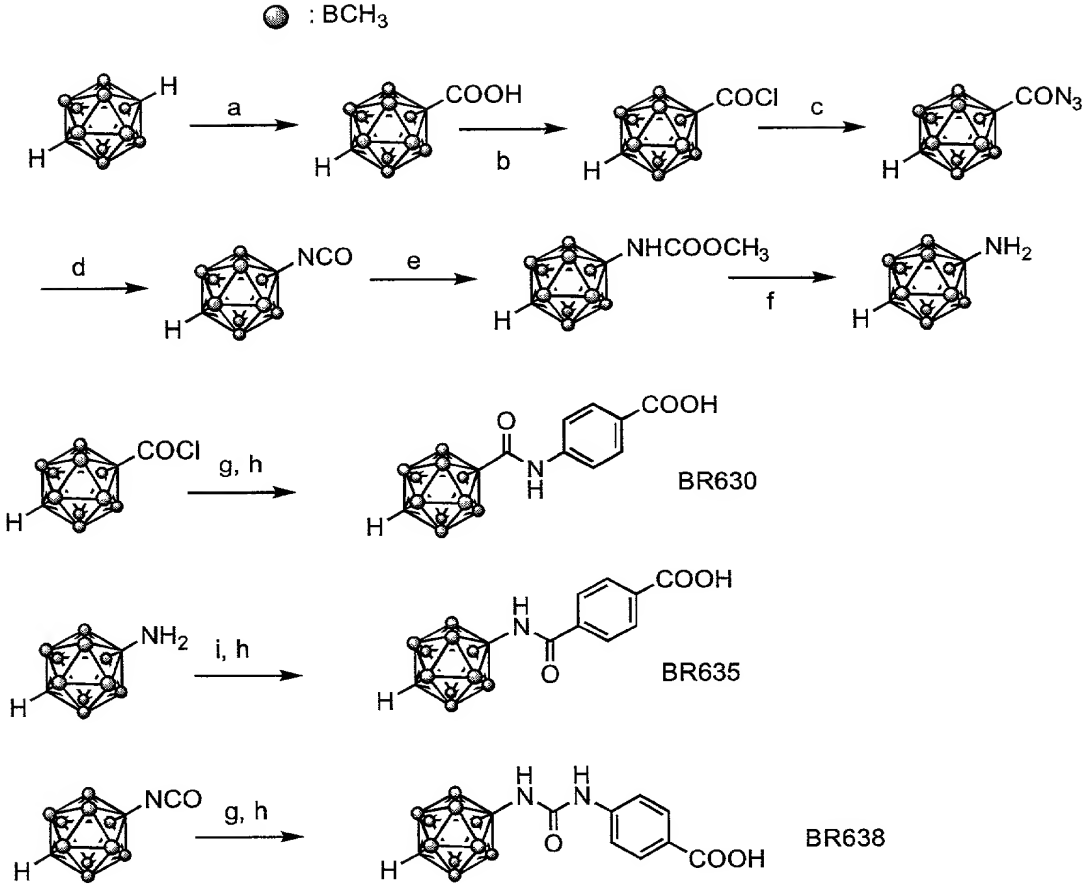
a) KOH/ H_2O-THF b) BBr_3/ CH_2Cl_2 c) DPPA, Et_3N, DMAP/ t-BuOH reflux d) CF_3COOH/ CH_2Cl2



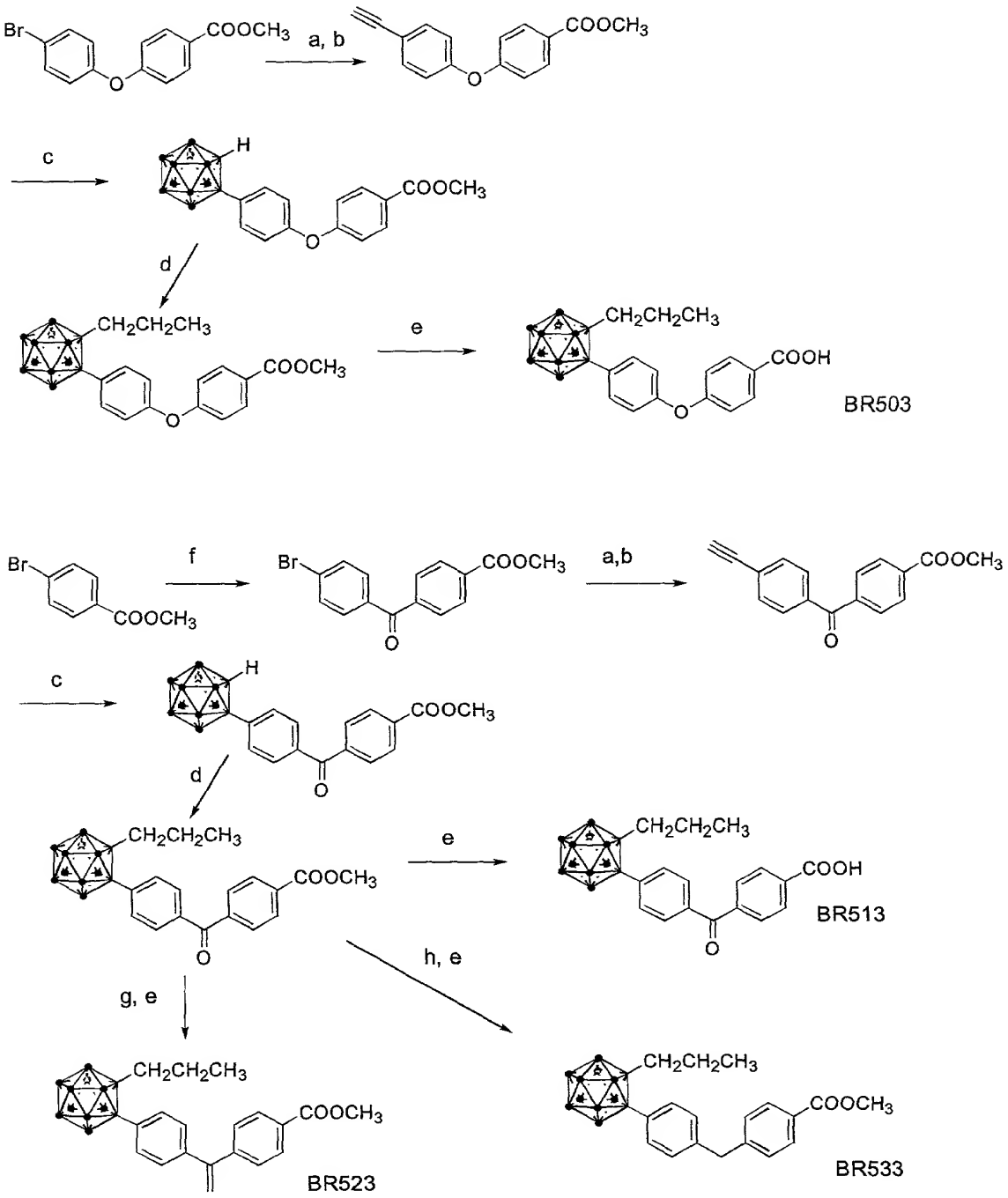
a) 1) n-BuLi/ Et_2O 2) CH_3COCl/ THF b) BBr_3/ CH_2Cl_2 c) $NaBH_4$, EtOH



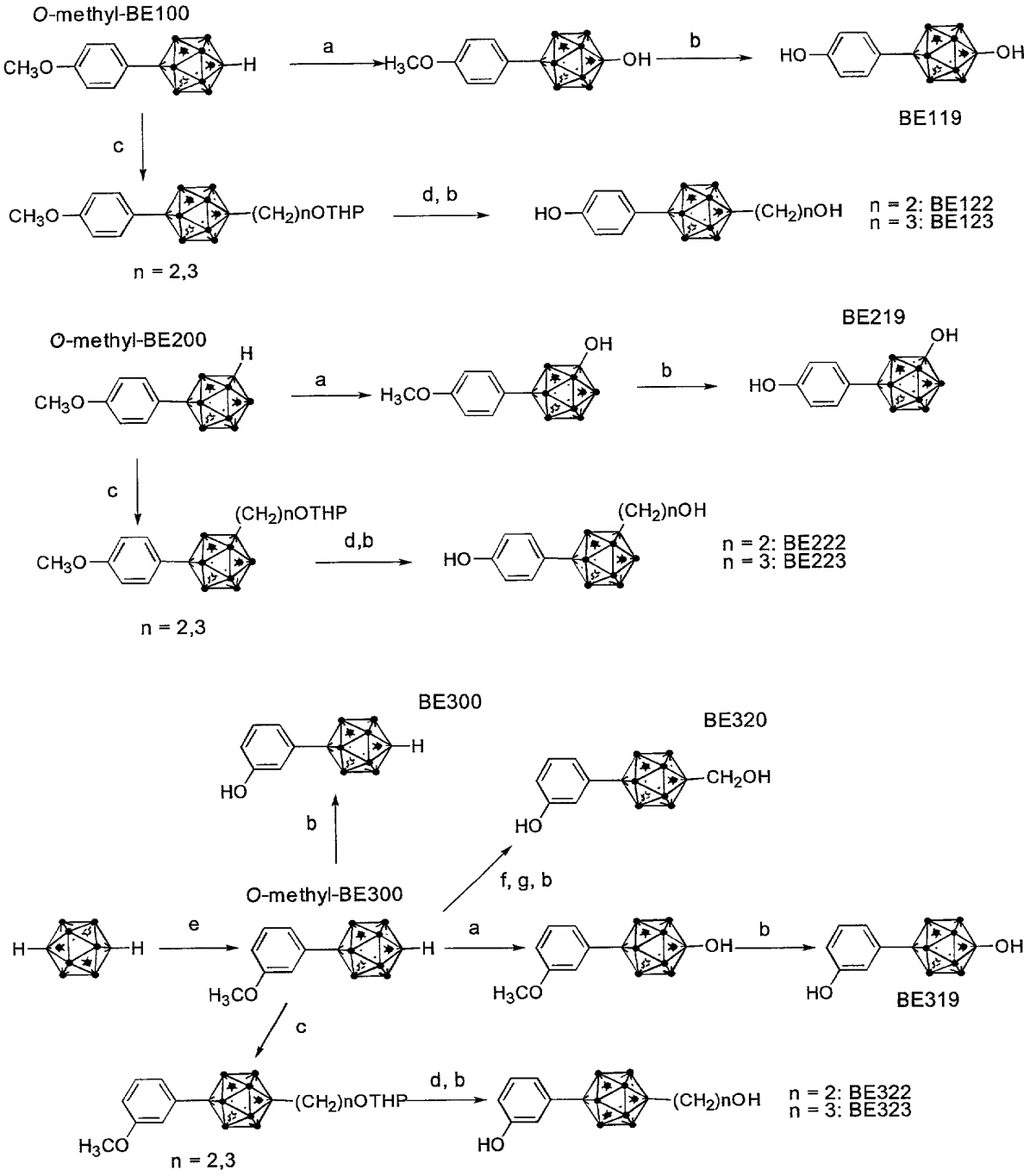
a) 1) n-BuLi, CuCl/DME 2) p-iodoanisole/ pyridine, reflux b) BBr_3/ CH_2Cl_2



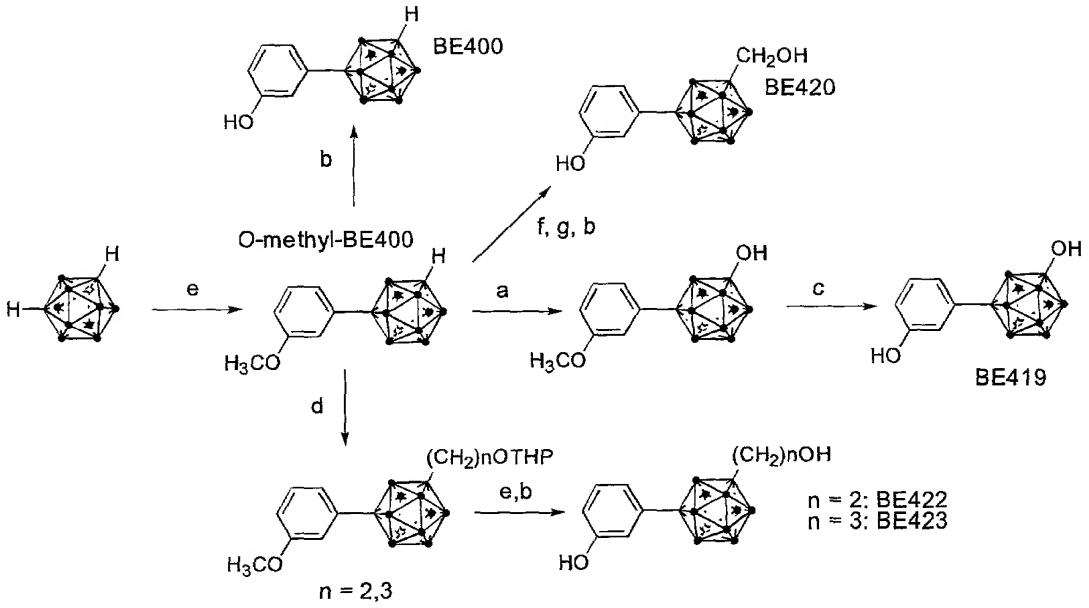
a) 1) CH_3Li/ THF 2) CO_2; b) $SOCl_2$/ dimethylformamide; c) NaN_3/ dimethylformamide; d) toluene, heat; e) CH_3OH; f) KOH/ H_2O-CH_3OH; g) ethyl 4-aminobenzoate/ *o*-dichlorobenzene, heat; h) KOH/ H_2O-C_2H_5OH; i) terephathalic acid monomethyl ester chloride/ *o*-dichlorobenzene, heat



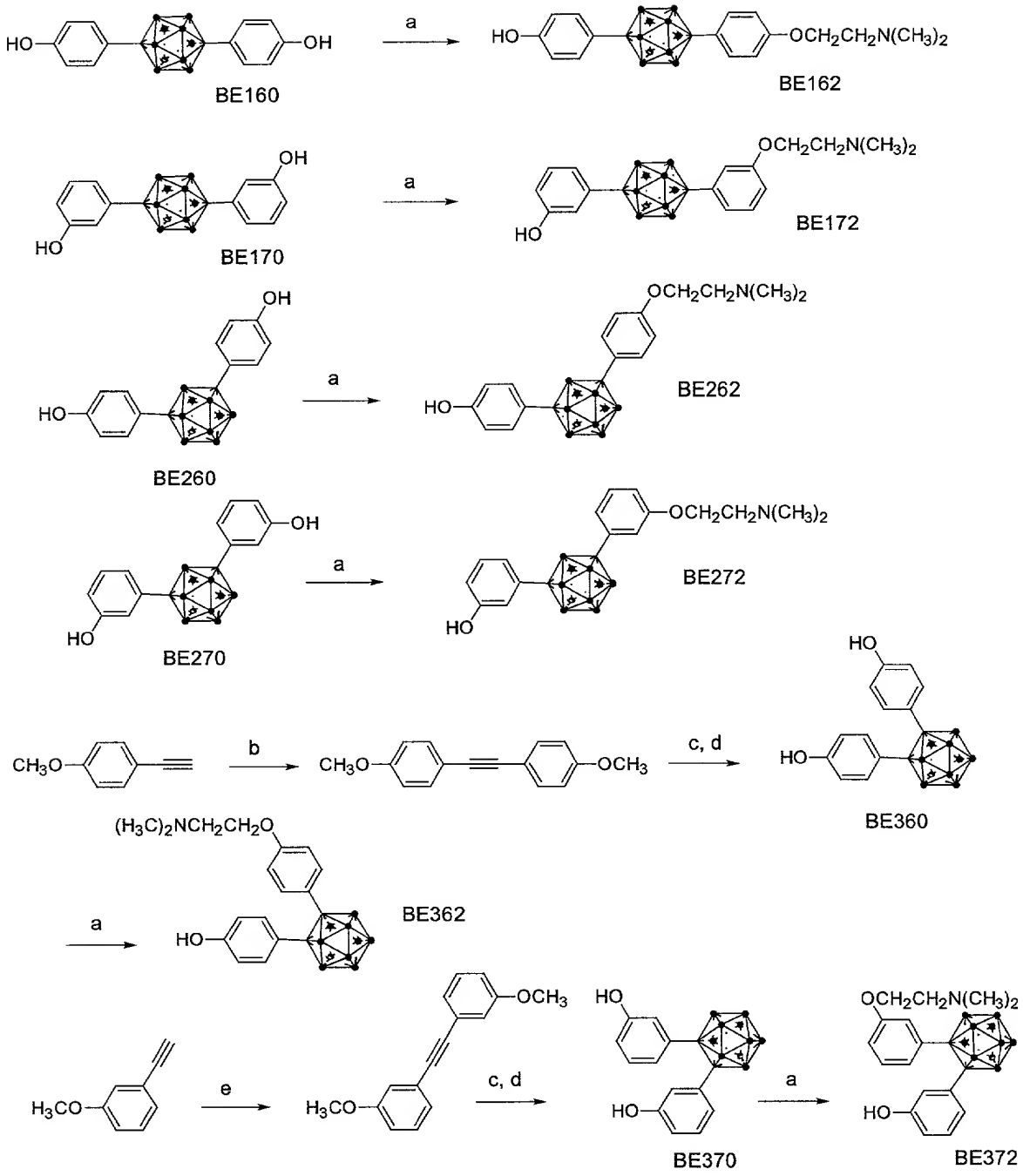
a) thynyltrimehylsilane, $(PPh_3)_2PdCl_2$, CuI, iPrNH. THF; b) K_2CO_3/ CH_3OH; c) decaborane (14)/ CH_3CN-C_6H_6; d) NaH, R-I (CH_3I or n-$CH_3CH_2CH_2I$)/ DMF; f) *n*-BuLi/ THF; e) H_2SO_4/ dioxane-H_2O; g) $[(C_6H_5)_3PCH_3]^+Br^-$, $NaNH_2$/ THF;h) $(C_2H_5)_3SiH$/ CF_3COOH-CH_2Cl_2



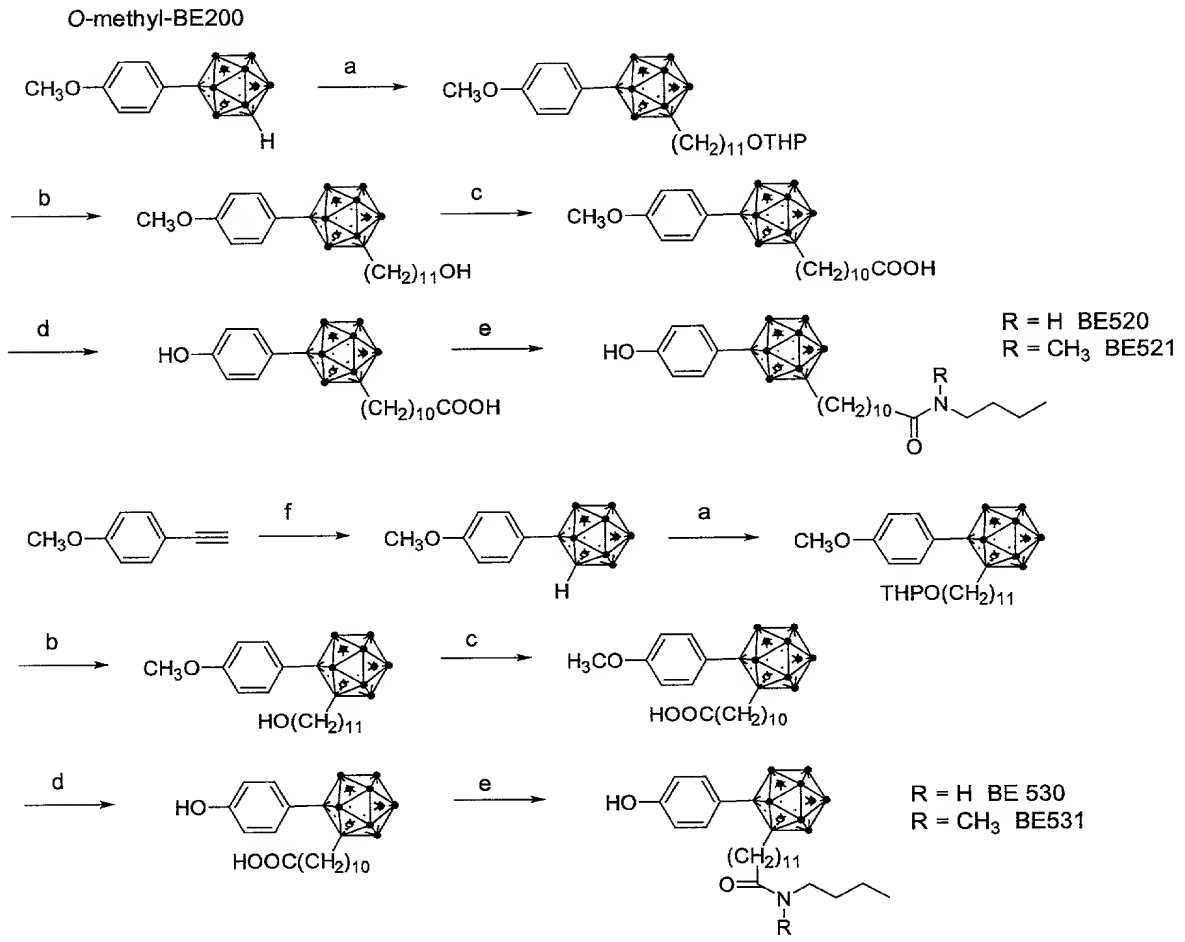
a) *n*-BuLi, $(C_6H_5COO)_2$/ benzene-Et_2O; b) BBr_3/ CH_2Cl_2; c) 1) *n*-BuLi, / benzene-Et_2O 2)$Br(CH_2)_nOTHP$; d) p-TsOH·H_2O/ CH_3OH; e) 1) *n*-BuLi, CuCl/DME 2) 3-iodoanisole/ pyridine; f) *n*-BuLi, / benzene-Et_2O 2) $ClCOOCH_3$; g) $LiAlH_4$/ THF



a) *n*-BuLi, $(C_6H_5COO)_2$/ benzene-Et_2O; b) BBr_3/ CH_2Cl_2; c) 1) *n*-BuLi, / benzene-Et_2O 2)$Br(CH_2)_nOTHP$; d) p-TsOH·H_2O/ CH_3OH; e) 1) *n*-BuLi, CuCl/DME 2) 3-iodoanisole/ pyridine f) *n*-BuLi, / benzene-Et_2O 2) $ClCOOCH_3$; g) $LiAlH_4$/ THF



a) $(CH_3)_2NCH_2CH_2Cl{\cdot}HCl$, K_2CO_3/ DMF; b) 4-iodoanisole, $(PPh_3)_2PdCl_2$, CuI, diisopropylamine/ THF; c) decaborane(14), acetonitrile/ benzene; d) BBr_3, CH_2Cl_2; e) 3-iodoanisole, $(PPh_3)_2PdCl_2$, CuI, diisopropylamine/ THF



a) 1) *n*-BuLi/ DME 2) CuCl 3) 2-(11-bromo-*n*-undecanyloxy)tetrahydro-2*H*-pyrane, pyridine; b)*p*-toluenesulfonic acid/ CH_3OH; c) CrO_3, 20% sulfuric acid/ acetone; d) BBr_3/ CH_2Cl_2; e) *n*-butylamine or *N*-*n*-butyl-*N*-methylamine, dicyclohexylcarbodiimide/ acetonitrile; f) decaborane(14), acetonitrile/ benzene

The compounds represented by formula (I) have an action as a ligand of a nuclear receptor (a retinoic acid receptor) to specifically regulate transcriptional activation by the retinoic acid receptor. More specifically, the compounds have affinity to retinoic acid receptor RAR or retinoic acid receptor RXR, and can function as an agonist or an antagonist for these receptors. Some of the compounds have an action of enhancing activities of retinoic acid. On the basis of these functions, the compounds represented by formula (I) can prevent proliferation of leukemia cells and promote differentiation to normal cells. Therefore, the compounds are useful as a medicaments for therapeutic treatment of leukemia by differentiation inducing therapy, and also useful for therapeutic and/or preventive treatment of cancer,

rheumatism, arteriosclerosis, diabetes, rejection reaction due to organ transplantation, and graft versus host disease. Moreover, they can be used as medicament for ^{10}B-Neutron Capture Therapy based on targeting to cancer cells utilizing the affinity to the nuclear receptor. Furthermore, they can be used as estrogenic agents.

As the active ingredient of the medicament of the present invention, the compound represented by the aforementioned formula (I) or a physiologically acceptable salt thereof, a hydrate thereof or a solvate thereof can be used. As the medicament of the present invention, the aforementioned active ingredient, per se, may be administered. However, generally it is desirable that a pharmaceutical composition is formulated which comprises the aforementioned active ingredient and one or more pharmaceutical additives and then administered. The route of administration of the medicament of the present invention is not limited. The medicament can be administered orally or parenterally.

Examples of the pharmaceutical compositions suitable for oral administrations include tablets, capsules, powders, subtilized granules, granules, liquids, syrups and the like. Examples of the pharmaceutical compositions suitable for parenteral administrations include injections, drip infusions, suppositories, inhalants, eye drops, nasal drops, transdermally-adsorbable formulation, ointments, creams, patches and the like. Examples of pharmaceutical additives include excipients, disintegrators or disintegrating aids, binders, lubricants, coating agents, colorants, diluents, base materials, dissolving agents or solubilizers, isotonic agents, pH modifiers, stabilizers, propellants, adhesives and the like. Appropriate additives can be chosen and used depending on the type of the pharmaceutical composition. The doses of the medicament of the present invention are not particularly limited, and suitable doses can appropriately be chosen depending on the conditions such as the kind of the compound as an active ingredient, a purpose of preventive or therapeutic treatment, the type of a disease, the age and symptoms of a patient, the route of administration and the like.

Examples

The present invention will be more specifically explained by referring to the following examples. However, the scope of the present invention is not limited to these examples. The compound numbers in the examples correspond to those in the schemes shown above.

Example 1

1,2-dicarba-*closo*-dodecaborane-1-carboxylic acid (100 mg, 0.531mmol) was dissolved in dichloromethane (1 ml), and oxalyl chloride (101 mg, 0.795mmol) and catalytic amount of dimethyl formamide (DMF , one drop) were added, and the mixture was stirred at room temperature for 3h. Then the reaction mixture was concentrated. The residue and methyl 4-aminobenzoate (80.3 mg, 0.531mmol) were suspended in dichloromethane (2ml), 4-dimethylaminopyridine (130 mg, 1.06mmol) was added at 0℃, stirred at room temperature for 1h under argon atmosphere. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with dichloromethane. The organic layer was washed with water, saturated sodium hydrogencarbonate solution, water, and brine in order, and dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent: hexane/ethylacetate=5/1) to give methyl 4-[(1,2-dicarba-*closo*-dodecaboran-1-yl)carbamoyl]benzoate (58 %).

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, m), 3.92 (3H, s), 4.35 (1H, br s), 7.55 (2H, d, J = 8.8 Hz), 7.71 (1H, br s), 8.06 (2H, d, J = 8.8 Hz).

4-[(1,2-dicarba-*closo*-dodecaboran-1-yl)carbamoyl]methyl benzoate (73 mg, 0.227mmol) was dissolved in tetrahydrofuran (THF)(1 ml), 1N potassium hydroxide (0.91ml) was added, and the mixture was stirred at room temperature for 16 h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and brine, dried over sodium sulfate and concentrated. The reaction mixture was purified by silica gel flash column chromatography to give BR10 (60%).

BR10 : colorless needles (ethyl acetate/dichloromethane)

m.p. : 249-251℃

^{1}H-NMR ($CDCl_3$) δ :1.00-3.30 (10H, br m), 4.36 (1H, br s), 7.59 (2H, d, J = 8.8 Hz), 7.75 (1H, br s), 8.12 (2H, d, J = 8.8 Hz)

Anal. Calcd for $C_{10}H_{17}B_{10}NO_3$: C, 39.08; H, 5.57; N 4.56. Found C, 39.13; H, 5.58; N, 4.44.

BR20 was synthesized from1,7-dicarba-*closo*-dodecaborane-1-carboxylic acid by the same method as preparation of BR10.

BR20: colorless needles (ethyl acetate / dichloromethane)

m.p. : 271-273℃; ^{1}H-NMR (DMSO-d_6) δ :1.30-3.20 (10H, br m), 4.30 (1H, br s), 7.69 (2H, d, J = 8.8 Hz), 7.89 (2H, d, J = 8.8 Hz), 9.74 (1H, s), 12.87 (1H, br s).

HRMS Calcd for $C_{10}H_{17}B_{10}NO_3$ 307.2246, Found 307.2235

BR30 was synthesized from 1,12-dicarba-*closo*-dodecarorane-1-carboxylic acid by the same method as preparation of BR10.

BR30 : Colorless needles (ethyl acetate / hexane); m.p. : > 300℃;

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 3.94 (1H, br s), 7.61 (2H, d, J = 8.8 Hz), 7.86 (2H, d, J = 8.8 Hz), 9.36 (1H, s), 12.80 (1H, br s).

Anal. Calc. for $C_{10}H_{17}B_{10}NO_3$: C, 39.08; H, 5.57; N, 4.56. Found C, 39.30; H, 5.54; N, 4.35.

Example 2

Ethynyltrimethylsilane (5.0 g, 50.9 mmol) was dissolved in dry diethyl ether (50 ml), 1.6 M n-butyllithium in hexane(35.0 ml, 56.0 mmol) was added dropwise at 0℃ under argon atmosphere. The mixture was stirred at the same temperature for 1h. DMF(3.72g, 50.9mmol) was dissolved in diethyl ether (20ml), and was added dropwise below 5℃ for 30 min, then the mixture was stirred at room temperature for 2 h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with diethyl ether. The organic layer was washed with water, saturated sodium hydrogencarbonate solution, and brine in order, and dried over sodium sulfate. Purification by distillation (40-45℃/15mmHg) gave 3-(trimethylsilyl)propiol aldehyde (28%).

Colorless oil

^{1}H-NMR ($CDCl_3$) δ :0.27 (9H, s), 9.17 (1H, s).

To a suspension of sodium hydride (556 mg, 13.9mmol) in THF (7 ml), diethyl phosphonoethyl acetate (3.12g, 13.9 mmol) in THF (7ml) was added dropwise under argon atmosphere. The mixture was stirred at room temperature for 30 min, then 3-(trimethylsilyl) propiolaldehyde in THF(7 ml) was added dropwise at 0℃. The mixture was stirred at room temperature for 1.5h, then poured into ice water, and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate, and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane→hexane/ethyl acetate=50/1) to give ethyl 5-trimethylsilyl-(E)-2 -penten-4-ynoate(65%).

Colorless oil

^{1}H-NMR ($CDCl_3$) δ :0.21 (9H, s), 1.29 (3H, t, J = 7.2 Hz), 4.21 (2H, q, J = 7.2 Hz), 6.24 (1H, d, J = 15.9 Hz), 6.74 (1H, d, J = 15.9 Hz).

Potassium carbonate (563mg, 4.07mmol) was added to a solution of ethyl 5-trimethylsilyl-(E)-2-penten-4-ynoate(800mg, 4.07mmol) in ethanol (10 ml), and the mixture was stirred at room temperature for 1h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography to give ethyl (E)-2-penten-4-ynoate (79%).

Colorless oily substance

^{1}H-NMR ($CDCl_3$) δ :1.30 (3H, t, J = 7.1 Hz), 3.34 (1H, dd, J = 0.7, 2.4 Hz), 4.23 (2H, q, J = 7.1 Hz), 6.32 (1H, dd, J = 0.7, 15.9 Hz), 6.72 (1H, dd, J = 2.4, 15.9 Hz).

A mixture of ethyl (E)-2-penten-4-ynoate(360mg, 2.90mmol) and decaborane (14) (532 mg, 4.35 mmol) in acetonitrile (1.5 ml) and benzene (15 ml) was refluxed for 17h under argon atmosphere. After the mixture was concentrated, it was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=10/1) to give 3-(1,2-dicarba-*closo*- dodecaboran-1-yl)-(E)-ethyl acrylate (64%).

Colorless prisms (hexane)

m.p. : 68-69℃

^{1}H-NMR ($CDCl_3$) δ :1.30 (3H, t, J = 7.1 Hz), 1.50-3.40 (10H, br m), 3.69 (1H, br s), 4.22 (2H, q, J = 7.1 Hz), 6.20 (1H, d, J = 15.4 Hz), 6.84 (1H, d, J = 15.4 Hz)

Anal. Calcd for $C_7H_{18}B_{10}O_2$: C, 34.70; H, 7.49. Found C, 34.41; H, 7.66.

To a solution of 3-(1,2-dicarba-*closo*-dodecaboran-1-yl)-(E)-ethyl acrylate (220 mg, 0.908 mmol) in THF(5 ml), 1N potassium hydroxide (1.82 ml) was added, and the mixture was stirred at room temperature for 7h. The reaction was quenched by the addition of 2N hydrochloric acid, and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : chloroform/methanol= 10/1) to give 3-(1,2-dicarba-*closo*-dodecaboran-1-yl) -(E)-propenoic acid (74%).

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 5.47 (1H, br s), 6.22 (1H, d, J = 15.4 Hz), 6.92 (1H, d, 15.4 Hz), 13.00 (1H, br).

The propenoic acid (60 mg, 0.28 mmol) obtained above was dissolved in dichloromethane (1 ml), oxalyl chloride (53.3 mg, 0.42 mmol) and catalytic amount of DMF(one drop) were added. The mixture was stirred at room temperature for 1h, and was concentrated. The residue was dissolved in pyridine (1 ml), and 4-amino methylbenzoate (46.6 mg, 0.308 mmol) was added. After stirring at room temperature for 18h, the reaction was quenched by the addition of 2N hydrochloric acid, the mixture was extracted with ethyl acetate. The organic layer was washed with water, saturated sodium hydrogencarbonate solution, water, and brine in order, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) to give methyl 4-[2-(1,2-dicarba-*closo*-decaborane-1-yl)-(E)-ethenylcarboxamine]benzoate (44%).

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, m), 3.72 (1H, br s), 3.91 (3H, s), 6.37 (1H, d, J = 15.0 Hz), 6.96 (1H, d, J = 15.0 Hz), 7.40 (1H, br s), 7.64 (2H, d, J = 8.8 Hz), 8.04 (2H, d, J = 8.8 Hz)

HRMS Calcd for $C_{13}H_{21}B_{10}NO_3$ 347.2524, Found 347.2534

The methyl benzoate (36mg, 0.104 mmol) obtained above was dissolved in

THF(1ml), 1N potassium hydroxide(0.468 ml) was added, and stirred at room temperature for 36h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water, and then with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : chloroform/methanol=50/1→5/1) to give 4-[2-(1,2-dicarba-*closo*-dododecaboran-1-yl)-(E)-ethenylcarboxamide] benzoic acid (BR110) (39%).

Colorless needles (ethyl acetate/hexane)

m.p. : > 300℃; ^{1}H-NMR ($CDCl_3$) δ :1.40-3.20 (10H, br m), 5.50 (1H, br s), 6.67 (1H, d, J = 15.1 Hz), 6.98 (1H, d, J = 15.1 Hz), 7.73 (2H, d, J = 8.8 Hz), 7.92 (2H, d, J = 8.8 Hz), 10.62 (1H, s), 12.75 (1H, br)

HRMS Calcd for $C_{12}H_{19}B_{10}NO_3$ 333.2368, Found 333.2367

Example 3

A mixture of ethenylbenzene (5.51g, 53.9 mmol) and decaborane (14)(2.64g, 21.6 mmol) in acetonitrile (5.5 ml) and benzene (55 ml) was refluxed for 4 days under argon atmosphere. Then the mixture was concentrated, it was purified by silica gel column chromatography (eluent : hexane) to give 1-phenyl-1,2-dicarba-*closo*-dodecaborane(74%).

Colorless prisms (hexane)

m.p. : 66-67℃

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 3.97 (1H, br s), 7.33 (2H, m), 7.39 (1H, m), 7.49 (2H, m).

1-Phenyl-1,2-dicarba-*closo*-dodecaborane (950mg, 4.31 mmol) was dissolved in dry diethylether (15 ml), 1.54M n-butyl lithium in hexane solution(2.8ml, 4.31 mmol) was added dropwise at 0℃ under argon atmosphere. After the mixture was stirred at room temperature for 3h, it was cooled to −78℃. Methyl iodide (673mg, 4.74 mmol) in THF(3 ml) was added dropwise, and further stirred at room temperature for 16h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with diethylether. The organic layer was washed with water, and then with brine, dried over sodium sulfate and concentrated. The residue was purified by silica

gel flash column chromatography(eluent : hexane) to give 1-methyl-2-phenyl-1,2-dicarba-*closo*-dodecaborane(94%).

Colorless prisms (hexane)

m.p. : 102-103℃

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 1.69 (3H, s), 7.39 (2H, m), 7.45 (1H, m), 7.65 (2H, m)

HRMS Calcd for $C_9H_{18}B_{10}$ 234.2412, Found 234.2422

A solution of 1-methyl-2-phenyl-1,2-dicarba-*closo*-dodecaborane(900 mg, 3.84mmol) in dichloromethane (17.5 ml) was added dropwise to a mixture of concentrated nitric acid and concentrated sulfuric acid (15:85, v/v, 17.5 ml) at 0℃, and stirred at room temperature for 4 h. The mixture was poured into ice water, and extracted with dichloromethane. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=30/1) to give 4-(2-methyl-1,2-dicarba-*closo*- dodecaboran-1-yl)nitrobenzene(a)(34%) and 3-(2-methyl-1,2-dicarba-*closo* -dodecaboran-1-yl)nitrobenzene(b)(57%).

colorless prisms (ethyl acetate/hexane)

m.p. : 105-106℃

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 1.73 (3H, s), 7.87 (2H, d, J = 9.0 Hz), 8.26 (2H, d, J = 9.0 Hz)

HRMS Calcd for $C_9H_{17}B_{10}NO_2$ 279.2262, Found 279.2264

(b) colorless prisms (ethyl acetate/hexane)

m.p. : 126-127℃

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 1.74 (3H, s), 7.64 (1H, t, J = 8.1 Hz), 8.01 (1H, ddd, J = 1.1, 2.0, 8.1 Hz), 8.34 (1H, ddd, J = 1.1, 2.0, 8.1 Hz), 8.53 (1H, t, J = 2.0 Hz)

HRMS Calcd for $C_9H_{17}B_{10}NO_2$ 279.2262, Found 279.2243

4-(2-Methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)nitrobenzene (349 mg, 1.25 mmol) was dissolved in ethanol (25 ml), and was hydrogenated at room temperature for 1 h using 10% Pd/C(87 mg) under the atmospheric pressure of hydrogen. After

removal of catalyst by filtration, the filtrate was concentrated to give 4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline (95%).

^{1}H-NMR ($CDCl_3$) δ :1.40-3.50 (10H, br m), 1.68 (3H, s), 4.01 (2H, br), 6.62 (2H, d, J = 8.6 Hz), 7.39 (2H, d, J = 8.6 Hz).

The amine obtained above (100 mg, 0.401 mmol) was dissolved in pyridine (2.5 ml), terephthalic acid monomethyl ester chloride (119 mg, 0.599 mmol) was added at 0℃, and stirred at room temperature for 3h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water, saturated sodium hydrogen carbonate solution, water, and brine in order, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : dichloromethane /hexane = 3/2→2/1) to give methyl 4-[4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylcarbamoyl]benzoate (96%).

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 1.71 (3H, s), 3.97 (3H, s), 7.66 (2H, d, J = 9.2 Hz), 7.70 (2H, d, J = 9.2 Hz), 7.91 (1H, br s), 7.93 (2H, d, J = 8.6 Hz), 8.18 (2H, d, J = 8.6 Hz).

The methyl benzoate obtained above (140 mg, 0.34 mmol) was dissolved in THF (2 ml), 1N potassium hydroxide (0.68 ml) was added, and stirred at room temperature for 14 h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : chloroform/methanol=5/1) to give 4-[4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)-phenylcarbamoyl]benzoic acid (BR201)(98%).

Colorless needles (ethyl acetate/hexane)

m.p. : > 300℃

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 1.74 (3H, s), 7.71 (2H, d, J = 8.8 Hz), 7.91 (2H, d, J = 8.8 Hz), 8.04 (2H, d, J = 8.6 Hz), 8.08 (2H, d, J = 8.6 Hz), 10.66 (1H, s), 13.32 (1H, br)

Anal. Calcd for $C_{17}H_{23}B_{10}NO_3$: C, 51.37; H, 5.83; N, 3.52. Found C, 51.13; H, 5.68; N,

3.37.

3-(2-Methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)nitrobenzene was converted to 4-[3-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylcarbamoyl]benzoic acid (BR251) employing the method described above.

Colorless needles (ethyl acetate/hexane)

m.p. : 284-286℃

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 1.77 (3H, s), 7.45 (1H, br d, J = 8.2 Hz), 7.49 (1H, t, J = 8.2 Hz), 8.05 (1H, br d, J = 8.2 Hz), 8.06 (2H, d, J = 8.6 Hz), 8.09 (2H, d, J = 8.6 Hz), 8.25 (1H, br s), 10.61 (1H, s), 13.30 (1H, br)

HRMS Calcd for $C_{17}H_{23}B_{10}NO_3$ 397.2681, Found 397.2683

Anal. Calcd for $C_{17}H_{23}B_{10}NO_3/0.2\ H_2O$: C, 50.91; H, 5.88; N, 3.49. Found C, 50.71; H, 5.97; N, 3.36.

Example 4

A mixture of ethyl 4-bromobenzoate (1.5 g, 6.55 mmol), ethynyl trimethylsilane (965 mg, 9.82 mmol), diisopropylamine (1.39 g, 13.7 mmol), cuprous iodide(25mg, 0.131mmol), and bis(triphenylphosphine) palladium(II) chloride (184 mg, 0.262 mmol) was heated at 45℃ for 4 h in dry THF (10 ml) under argon atmosphere. The reaction was quenched by the addition of water, and the mixture was extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=100/1) to give ethyl 4-[(trimethylsilyl)ethynyl]benzoate (73%).

^{1}H-NMR ($CDCl_3$) δ :0.26 (9H, s), 1.39 (3H, t, J = 7.2 Hz), 4.37 (2H, q, J = 7.2 Hz), 7.51 (2H, d, J = 8.6 Hz), 7.97 (2H, d, J = 8.6 Hz).

4-[(Trimethylsilyl)ethynyl]ethyl benzoate (1.15 g, 4.67 mmol) was dissolved in THF (10 ml), 1M tetrabutylammonium fluoride/THF solution (5.14 ml) was added dropwise at 0℃. After stirring at room temperature for 30 min, the reaction was quenched by the addition of water, and the mixture was extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated.

The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=20/1) to give 4-ethynylethylbenzoate(40%).

Colorless oily substance

^{1}H-NMR ($CDCl_3$) δ :1.40 (3H, t, J = 7.1 Hz), 3.23 (1H, s), 4.38 (2H, q, J = 7.1 Hz), 7.55 (2H, d, J = 8.2 Hz), 8.00 (2H, d, J = 8.2 Hz).

A mixture of 4-ethynyl ethyl benzoate(320 mg, 1.84 mmol) and decaborane(14) (337 mg, 2.76 mmol) was refluxed for 3 days in acetonitrile (1 ml) and benzene (15 ml) under argon atmosphere,. The mixture was concentrated and purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=15/1) to give ethyl 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)benzoate (71%).

Colorless flakes (ethanol)

m.p. : 111-112℃

^{1}H-NMR ($CDCl_3$) δ :1.39 (3H, t, J = 7.1 Hz), 1.50-3.50 (10H, br m), 4.01 (1H, br s), 4.39 (2H, q, J = 7.1 Hz), 7.54 (2H, d, J = 8.8 Hz), 8.00 (2H, d, J = 8.8 Hz)

HRMS Calcd for $C_{11}H_{20}B_{10}O_2$ 292.2466, Found 292.2487

Ethyl 4-(1,2-dicarba-*closo*-dodecaboran-1-yl) benzoate (374 mg, 1.28 mmol) was dissolved in THF (5 ml), 1N potassium hydroxide (3.84 ml) was added, and stirred at room temperature for 15h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated. The remaining crystals were washed with hexane to give 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)benzoic acid.

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 5.88 (1H, br s), 7.72 (2H, d, J = 8.5 Hz), 7.94 (2H, d, 8.5 Hz), 13.29 (1H, br).

The benzoic acid obtained above (140 mg, 0.53 mmol) was suspended in dichloromethane (1.51 ml), oxalyl chloride (202 mg, 1.59 mmol) and catalytic amount of DMF(1 drop) were added. After stirring at room temperature for 1h, the mixture was concentrated. The residue was dissolved in pyridine (1.5 ml), and methyl 4-aminobenzoate (84.0 mg, 0.556 mmol) was added. After stirring at room

temperature for 15h, the reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water, saturated sodium hydrogencarbonate solution, water, and brine in order, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=3/1) to give methyl 4-{[4-(1,2-dicarba-*closo*-dodecaboran-1-yl)phenyl]carboxamide}benzoate (48%).
^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, m), 3.92 (3H, s), 4.02 (1H, br s), 7.62 (2H, d, J = 8.4 Hz), 7.72 (2H, d, J = 8.8 Hz), 7.84 (2H, d, J = 8.4 Hz), 7.89 (1H, br s), 8.07 (2H, d, J = 8.8 Hz).

The methyl benzoate obtained above (94 mg, 0.236 mmol) was dissolved in THF(3 ml), 1N potassium hydroxide (1.18 ml) was added, and stirred at 40℃ for 16h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : chloroform/methanol=5/1) to give 4-{[4-(1,2-dicarba-*closo*-dodecaboran-1-yl)phenyl]carboxamide}benzoic acid (BR300)(41%).
Colorless needles (ethyl acetate)
m.p. : > 300℃
^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 5.92 (1H, br s), 7.76 (2H, d, J = 8.8 Hz), 7.88 (2H, d, J = 8.8 Hz), 7.94 (2H, d, J = 8.8 Hz), 7.95 (2H, d, J = 8.8 Hz), 10.61 (1H, s), 12.80 (1H, br)
Anal. Calcd for $C_{16}H_{21}B_{10}NO_3$: C, 50.12; H, 5.52; N, 3.65. Found C, 50.18; H, 5.80; N, 3.41.

A mixture of ethyl 3-bromobenzoate (1.0 g, 4.37 mmol), ethynyl trimethylsilane (644 mg, 6.56 mmol), diisopropylamine (929 mg, 9.20 mmol), cuprous iodide(I) (16.6 mg, 0.0872 mmol), and bis(triphenylphosphine) palladium(II) chloride (123 mg, 0.175 mmol) was heated at 45℃ for 5h in dried THF (8 ml) under argon atmosphere. After cooling, the reaction was quenched by the addition of water, and the mixture was extracted with ethyl acetate. The organic layer was washed with brine, dried over

sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=50/1) to give ethyl 3-[(trimethylsilyl)-ethynyl]benzoate (90%)

^{1}H-NMR ($CDCl_3$) δ :0.26 (9H, s), 1.40 (3H, t, J = 7.1 Hz), 4.38 (2H, q, J = 7.1 Hz), 7.38 (1H, dd, J = 7.3, 8.3 Hz), 7.63 (1H, d, J = 7.3 Hz), 7.98 (1H, d, J = 8.3 Hz), 8.13 (1H, s).

Potassium carbonate (583 mg, 4.22 mmol) was added to an ethanol solution (10 ml) of ethyl 3-[(trimethylsilyl)ethynyl]benzoate (1.04 g, 4.22 mmol), and stirred at room temperature for 2h. The mixture was concentrated, and the residue was dissolved in ethyl acetate. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=30/1) to give ethyl 3-ethynylbenzoate (96%).

Colorless needles

m.p. : 36-37℃

^{1}H-NMR ($CDCl_3$) δ :1.40 (3H, t, J = 7.1 Hz), 3.12 (1H, s), 4.34 (2H, q, J = 7.1 Hz), 7.41 (1H, t, J = 7.8 Hz), 7.66 (1H, dt, J = 7.8, 1.5 Hz), 8.03 (1H, dt, J = 7.8, 1.5 Hz), 8.17 (1H, t, J = 1.5 Hz).

Ethyl 3-ethynyl benzoate was reacted with decaborane(14) and converted to ethyl 3-(1,2-dicarba-*closo*-dodecaboran-1-yl)benzoate similar to the case of ethyl 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)benzoate. The yield of the product was 68%.

Colorless flakes (ethanol)

m.p. : 168-169℃

^{1}H-NMR ($CDCl_3$) δ :1.41 (3H, t, J = 7.7 Hz), 1.50-3.50 (10H, m), 4.04 (1H, br s), 4.40 (2H, q, J = 7.1 Hz), 7.43 (1H, t, J = 7.7 Hz), 7.70 (1H, ddd, J = 1.1, 2.2, 7.7 Hz), 8.07 (1H, dt, J = 7.7, 1.1 Hz), 8.10 (1H, t. J = 1.7 Hz)

HRMS Calcd for $C_{11}H_{20}B_{10}O_2$ 292.2466, Found 292.2474

4-[[3-(1,2-Dicarba-*closo*-dodecaboran-1-yl)phenyl]carboxamide]benzoic acid (BR350) was prepared from 3-(1,2-dicarba-*closo*-dodecaboran-1-yl)ethylbenzoate by the same procedure that used for BR300.

Colorless needles (ethyl acetate/hexane)

m.p. : 236-239℃

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 5.89 (1H, br s), 7.60 (1H, t, J = 8.0 Hz), 7.82 (1H, br d, J = 8.0 Hz), 7.86 (2H, d, J = 8.8 Hz), 7.95 (2H, d, J = 8.8 Hz), 8.04 (1H, br d, J = 8.0 Hz), 8.05 (1H, br s), 10.61 (1H, s), 12.89 (1H, br)

HRMS Calcd for $C_{16}H_{21}B_{10}NO_3$ 383.2524, Found 383.2542

Anal. Calcd for $C_{16}H_{21}B_{10}NO_3/0.5\ H_2O$: C, 48.97; H, 5.65; N, 3.57. Found C, 48.99; H, 5.83; N, 3.49.

Example 5

1.54M n-Butyl lithium/hexane solution (37.8 ml, 58.2 mmol) was added dropwise to DME solution (100 ml) of 1,2-dicarba-*closo*-dodecaborane (4.0 g, 27.7 mmol) at 0℃ under argon atmosphere. The mixture was stirred at room temperature for 30 min, cuprous chloride (7.13 g, 72.0 mmol) was added in one portion, and further stirred at room temperature for 2h. After the treatment, pyridine (16.7 ml, 208 mmol) was added, then 4-iodonitrobenzene (8.28 g, 33.3 mmol) was added at one time, and heated at 100℃ for 22h. After cooling, the mixture was diluted with diethyl ether, stirred at room temperature for 12h, and the insoluble substance was separated and filtered with Celite. The filtrate was washed with 2N hydrochloric acid, water, and brine in order, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : n-hexane/ethyl acetate=7/1) to give 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)nitrobenzene (75%).

Colorless prism (ethyl acetate/hexane)

m.p. : 170-172℃

^{1}H-NMR ($CDCl_3$) δ 1.50-3.50 (10H, br m), 4.02 (1H, br s), 7.67 (2H, d, J = 9.2 Hz), 8.21 (2H, d, J = 9.2 Hz)

4-(1,2-Dicarba-*closo*-dodecaboran-1-yl) nitrobenzene (5.45 g, 20.5 mmol) in ethanol (220 ml) was hydrogenated at room temperature for 3h under the atmospheric pressure of hydrogen using 10% Pd/C (1.36 g). After removal of catalyst by filtration, the filtrate was concentrated, and 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)aniline was obtained (85%).

^{1}H-NMR ($CDCl_3$) δ 1.50-3.50 (10H, br m), 3.83 (3H, br), 6.56 (2H, d, J = 9.2 Hz), 7.27 (2H, d, J = 9.2 Hz)

Sodium hydride (40.8 mg, 1.02 mmol) was suspended in DMF (1 ml), and a solution of 4-(1,2-dicarba-*closo*-dodecaboran-1-yl) aniline (200 mg, 0.850 mmol) in DMF (3 ml) was added to the suspension. The mixture was stirred at room temperature for 5 min, 1-indopropane (217 mg, 1.28 mmol) was added, and further stirred at room temperature for 1.5h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was neutralized with saturated sodium hydrogen carbonate solution, and extracted with diethyl ether. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) to give 4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl) aniline(82%).
^{1}H-NMR ($CDCl_3$) δ 0.74 (3H, t, J = 7.3 Hz), 1.41 (2H, m), 1.50-3.50 (10H, br m), 1.73 (2H, m), 3.90 (2H, br), 6.60 (2H, d, J = 8.8 Hz), 7.36 (2H, d, J = 8.8 Hz)

A mixture of 4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline (175 mg, 0.631 mmol), ethyl 4-iodobenzoate (192 mg, 0.695 mmol), cesium carbonate (288 mg, 0.884 mmol), tris(dibenzylideneacetone)dipalladium(0) (11.6 mg, 0.0127 mmol), and 2-2'-bis(diphenylphosphino)-1,1'-binaphtyl (19.6 mg, 0.0315 mmol) in dry toluene was heated at 100-110℃ for 27h. The reaction was quenched by the addition of water, the mixture was extracted with diethyl ether. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : dichloromethane/hexane=1/1) to give light yellow needless of ethyl 4-[4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)-phenylaminobenzoate (53%).
^{1}H-NMR ($CDCl_3$) δ 0.77 (3H, t, J = 7.3 Hz), 1.39 (3H, t, J = 7.1 Hz), 1.44 (2H, m), 1.50-3.50 (10H, br m), 1.76 (2H, m), 4.36 (2H, q, J = 7.1 Hz), 6.15 (1H, s), 7.09 (2H, d, J = 8.8 Hz), 7.10 (2H, d, J = 8.8 Hz), 7.52 (2H, d, J = 8.8 Hz), 7.98 (2H, d, J = 8.8 Hz)

Ethyl 4-[4-(2-Propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]-benzoate (130 mg, 0.305 mmol) was dissolved in water (1.5 ml)-dioxane (5 ml), then

concentrated sulfuric acid (1 ml) was added, and the mixture was heated at 100℃ for 15h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=2/1→1/1) to give 4-[4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino] benzoic acid (BR403)(68%).

Colorless needles (eluent : ethyl acetate/hexane)

m.p. : 216-217℃

^{1}H-NMR (DMSO-d_6) δ 0.71 (3H, t, J = 7.3 Hz), 1.36 (2H, m), 1.50-3.20 (10H, br m), 1.80 (2H, m), 7.17 (2H, d, J = 8.8 Hz), 7.19 (2H, d, J = 8.8 Hz), 7.55 (2H, d, J = 8.8 Hz), 7.84 (2H, d, J = 8.8 Hz), 9.06 (1H, s), 12.43 (1H, s)

Anal. Calcd for $C_{18}H_{27}B_{10}NO_2$: C,54.39; H, 6.85; N, 3.52. Found C, 54.09; H, 6.64; N, 3.45.

3-(1,2-Dicarba-*closo*-dodecaboran-1-yl)nitrobenzene was prepared from 1,2-dicarba-*closo*-dodecaborane (2.0 g, 13.9 mmol), 1.54 M n-butyl lithium/hexane solution (19.0 ml, 29.3 mmol), cuprous chloride (3.58 g, 36.2 mmol), pyridine (8.39 ml, 104 mmol), and 3-iodonitrobenzene (4.15 g, 16.7 mmol) by a similar procedure to the method applied for preparation of 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)nitrobenzene. The residue was purified by silica gel flash column chromatography to give 3-(1,2-dicarba-*closo*-dodecaboran-1-yl)nitrobenzene (34%) and 3-(1,2-dicarba-*closo*-dodecaboran-1-yl)aniline (9%).

Colorless prisms

m.p. : 142-143℃

^{1}H-NMR ($CDCl_3$) δ 1.50-3.50 (10H, br m), 4.03 (1H, br s), 7.58 (1H, t, J = 8.2 Hz), 7.86 (1H, ddd, J = 1.2, 1.8, 8.2 Hz), 8.28 (1H, ddd, J = 1.2, 1.8, 8.2 Hz), 8.34 (1H, t, J = 1.8 Hz)

3-(1,2-Dicarba-*closo*-dodecaboran-1-yl)nitrobenzene was reduced by a similar procedure that used for 4-(1,2-dicarba-*closo*-dodecaboran-1-yl)aniline. Purification by silica gel column chromatography gave 3-(1,2-dicarba-*closo*-dodecaboran-1-yl)aniline (76%).

^{1}H-NMR ($CDCl_3$) δ 1.40-3.50 (10H, br m), 3.85 (2H, br), 3.93 (1H, br s), 6.67 (1H, m), 6.78-6.81 (2H, m), 7.07 (1H, t, J = 8.2 Hz)

3-(1,2-Dicarba-*closo*-dodecaboran-1-yl)aniline was converted to 3-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline by a similar procedure that used for 4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline. Purification by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) gave 3-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline (92%).
^{1}H-NMR ($CDCl_3$) δ 0.74 (3H, t, J = 7.3 Hz), 1.43 (2H, m), 1.50-3.50 (10H, br m), 1.76 (2H, m), 3.80 (2H, br), 6.74 (1H, br d, J = 8.0 Hz), 6.91 (1H, br s), 6.98 (1H, br d, J = 8.0 Hz), 7.13 (1H, t, J = 8.0 Hz)

Ethyl 4-[3-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]-benzoate was prepared from 3-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline by a similar procedure that used for ethyl 4-[4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl) phenylamino]benzoate. Purification by silica gel flash column chromatography (eluent : dichloromethane/hexane = 1/1) gave light yellow crystals of ethyl 4-[3-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]benzoate (89%).
^{1}H-NMR ($CDCl_3$) δ 0.78 (3H, t, J = 7.3 Hz), 1.39 (3H, t, J = 7.1 Hz), 1.45 (2H, m), 1.50-3.50 (10H, br m), 1.79 (2H, m), 4.36 (2H, q, J = 7.1 Hz), 6.09 (1H, s), 7.00 (2H, d, J = 8.9 Hz), 7.23 (1H, m), 7.26 (1H, m), 7.32 (1H, t, J = 7.9 Hz), 7.39 (1H, br s), 7.97 (2H, d, J = 8.9 Hz)

This ester was hydrolyzed by a similar procedure that used for 4-[4-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]benzoic acid. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate = 2/1 →1/1) to give 4-[3-(2-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]benzoic acid (BR453) (80%).
Colorless needles (ethyl acetate/hexane)
m.p. : 229-230℃
^{1}H-NMR (DMSO-d_6) δ 0.72 (3H, t, J = 7.3 Hz), 1.38 (2H, m), 1.50-3.20 (10H, br m), 1.84 (2H, m), 7.08 (2H, d, J = 8.8 Hz), 7.22 (1H, br d, J = 7.1 Hz), 7.34-7.41 (3H, m), 7.83

(2H, d, J = 8.8 Hz), 8.94 (1H, s), 12.38 (1H, s)

Anal. Calcd for $C_{18}H_{27}B_{10}NO_2$: C, 54.39; H, 6.85; N, 3.52. Found C, 54.17; H, 6.78; N, 3.25.

Example 6

4-(2-Methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)nitrobenzene (349 mg, 1.25 mmol) was dissolved in ethanol (25 ml) and hydrogenated at room temperature for 1h under the atmospheric pressure of hydrogen using 10% Pd/C (87 mg),. After the catalyst was removed by filtration, the filtrate was concentrated to give 4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl) aniline (95%).

^{1}H-NMR ($CDCl_3$) δ :1.40-3.50 (10H, br m), 1.68 (3H, s), 4.01 (2H, br), 6.62 (2H, d, J = 8.6 Hz), 7.39 (2H, d, J = 8.6 Hz).

A mixture of 4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)aniline (174 mg, 0.698 mmol), 4-iodo ethyl benzoate (193 mg, 0.699 mmol), cesium carbonate (318 mg, 0.976 mmol), tris (dibenzylidene acetone) dipalladium (0)(12.8 mg, 0.0140 mmol), and 2-2'-bis(diphenylphosphino)-1,1'-binaphtyl (21.7 mg, 0.0348 mmol) in dry toluene was heated at 110℃ for 24h. The reaction was quenched by the addition of water, and the mixture was extracted with diethyl ether. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : dichloromethane /hexane =1/1) to give light yellow needles of ethyl 4-[4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenyl-amino] benzoate (71%).

^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 1.39 (3H, t, J = 7.1 Hz), 1.72 (3H, s), 4.36 (2H, q, J = 7.1 Hz), 6.15 (1H, br s), 7.09 (4H, d, J = 8.8 Hz), 7.54 (2H, d, J = 8.8 Hz), 7.98 (2H, d, J = 8.8 Hz).

Ethyl 4-[4-(2-Methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]-benzoate (95 mg, 0.239 mmol) was dissolved in THF(3 ml), 1N potassium hydroxide (1.20 ml) was added, and refluxed for 27h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then brine, dried over sodium sulfate and

concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=2/1) to give 4-[4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl) phenylamino] benzoic acid (BR401)(31%), and ethyl 4-[4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]benzoate was recovered (27%).

BR401 : Colorless needles (ethyl acetate/hexane)

m.p. : 258-260℃

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 1.73 (3H, s), 7.16 (2H, d, J = 8.8 Hz), 7.20 (2H, d, J = 8.8 Hz), 7.56 (2H, d, J = 8.8 Hz), 7.83 (2H, d, J = 8.8 Hz), 9.06 (1H, s), 12.42 (1H, br)

Anal. Calcd for $C_{16}H_{23}B_{10}NO_3$: C, 52.01; H, 6.27; N, 3.79. Found C, 52.11; H, 6.54; N, 3.64.

BR431 was synthesized from [4-(1,2-dicarba-*closo*-dodecaboran -1-yl)-2-methyl nitrobenzene by a similar procedure that used for ethyl 4-[4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenylamino]benzoate. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1→3/1) to give light orange needless of ethyl 4-{4-(1,2-dicarba-*closo*-dodecaboran-1-yl)-2-methy}-phenylamino]benzoate (61%).

^{1}H-NMR ($CDCl_3$) δ :1.38 (3H, t, J = 7.2 Hz), 1.50-3.50 (10H, br m), 2.26 (3H, s), 3.92 (1H, br s), 4.35 (2H, q, J = 7.2 Hz), 5.70 (1H, s), 6.95 (2H, d, J = 9.0 Hz), 7.23 (1H, d, J = 8.8 Hz), 7.27 (2H, dd, J = 2.4, 8.8 Hz), 7.33 (1H, d, J = 2.4 Hz), 7.95 (2H, d, J = 9.0 Hz).

Sodium hydride (33.2 mg, 0.830 mmol) was suspended in DMF (1 ml), and ethyl 4-{4-(1,2-dicarba-*closo*-dodecaboran-1-yl)-2-methy}phenylamino] benzoate (150 mg, 0.377 mmol) in DMF (3 ml) was added to the suspension. The mixture was stirred at room temperature for 5 min, methyl iodide (161 mg, 1.13 mmol) was added, and further stirred at room temperature for 20 min. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with diethyl ether. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=10/1) to give ethyl 4-{N-methyl-[2-methyl-4-(2 -methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)]phenylamino}benzoate (74%).

^{1}H-NMR ($CDCl_3$) δ :1.35 (3H, t, J = 7.1 Hz), 1.50-3.50 (10H, br m), 1.76 (3H, s), 2.14 (3H, s), 3.28 (3H, s), 4.35 (2H, q, J = 7.1 Hz), 6.48 (2H, d, J = 9.2 Hz), 7.16 (1H, d, J = 8.4 Hz), 7.53 (1H, dd, J = 2.4, 8.4 Hz), 7.57 (1H, d, J = 2.4 Hz), 7.88 (2H, d, J = 9.2 Hz).

Ethyl 4-[N-Methyl-[2-methyl-4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)]phenylamino] ethyl benzoate (111 mg, 0.261 mmol) was dissolved in THF (3 ml), 1N potassium hydroxide (1.95 ml) was added, and refluxed for 26h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=2/1) to give 4-{N-methyl-[2-methyl-4-(2-methyl-1,2 -dicarba-*closo*-dodecaboran-1-yl)] phenylamino} benzoic acid (BR431) (12%), and ethyl 4-[N-methyl-[2 -methyl-4-(2-methyl-1,2-dicarba-*closo*-dodecaboran-1-yl)] phenylamino]benzoate was recovered (16%).

BR431 : Colorless needles (ethyl acetate/hexane)

m.p. : 296-298℃

^{1}H-NMR (DMSO-d_6) δ :1.40-3.20 (10H, br m), 1.80 (3H, s), 1.99 (3H, s), 3.24 (3H, s), 6.51 (2H, d, J = 9.1 Hz), 7.31 (1H, d, J = 8.3 Hz), 7.63 (1H, dd, J = 2.5, 8.3 Hz), 7.69 (1H, d, J = 2.5 Hz), 7.74 (2H, d, J = 9.1 Hz), 12.18 (1H, br s)

Anal. Calcd for $C_{16}H_{23}B_{10}NO_3$: C, 54.39; H, 6.85; N, 3.52. Found C, 54.25; H, 6.95; N, 3.53.

Example 7

1,12-Dicarba-*closo*-dodecaborane (3.5 g, 24.3 mmol) was dissolved in DME, 1.54 M n-butyl lithium/hexane solution (16.6 ml, 25.6 mmol) was added dropwise at 0℃ under argon atmosphere. The mixture was stirred at room temperature for 30 min, cuprous chloride (3.13 g, 31.6 mmol) was added in one portion, and further stirred at room temperature for 1h. Then, pyridine (14.7 ml, 183 mmol) was added, and 4-iodo anisole (5.97 g, 25.5 mmol) was added in one portion, and heated at 100℃ for 48h. After cooling, the mixture was diluted with diethyl ether, then stirred at room temperature for 3h, and insoluble substance was separated by filtration with Celite. The filtrate was washed with 2N hydrochloric acid, $Na_2S_2O_3$ solution, water, and brine

in order, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane→hexane/ethyl acetate=10/1) to give 1-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane(O-methy-BE100)(60%) and 1,12-bis (4-methoxy phenyl)-1,12-dicarba-*closo*-dodecaborane (O,O'-dimethyl-BE160)(13%).

O-methy-BE100 : Colorless needles ; ^{1}H-NMR ($CDCl_3$) δ :1.50-3.30 (10H, br m), 2.75 (1H, br s), 3.74 (3H, s), 6.68 (2H, d, J = 9.1 Hz), 7.11 (2H, d, J = 9.1 Hz).

O, O'-dimethyl-B E 160 : Colorless needles ; ^{1}H-NMR ($CDCl_3$) δ :1.50-3.50 (10H, br m), 3.75 (6H, s), 6.69 (4H, d, J = 9.0 Hz), 7.15 (4H, d, J = 9.0 Hz).

O-Methyl-BE100 (100 mg, 0.399 mmol) was dissolved in dichloromethane (1 ml), 1M boron tribromide/dichloro methane solution (0.48 ml) was added dropwise under cooling with dry ice/acetone, and stirred at room temperature for 2h. The mixture was poured into ice water, and extracted with dichloromethane. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=10/1) to give 1-(4 -hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE100) (93%).

Colorless needles (dichloromethane/hexane)

m.p. : 193-194℃

^{1}H-NMR ($CDCl_3$) δ :1.40-3.20 (10 H, br m), 2.75 (1H, br s), 4.73 (1H, br s), 6.61 (2H, d, J = 9.0 Hz), 7.07 (2H, d, J = 9.0 Hz)

HRMS Calcd for $C_8H_{16}B_{10}O$ 236.2204, Found 236.2227

Anal. Calcd for $C_8H_{16}B_{10}O$: C, 40.66; H, 6.82. Found C, 40.67; H, 6.79.

O,O'-Dimethyl-BE160 (150 mg, 0.421 mmol) was dissolved in dichloro-methane(5 ml), 1M boron tribromide/dichloromethane solution (1.05 ml) was added dropwise under cooling with dry ice/acetone, and stirred at room temperature for 2h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) to give 1,12-bis(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane

(BE160) (93%).

Colorless prisms (ethyl acetate/hexane)

m.p. : 292-294℃ ; ^{1}H-NMR (DMSO-d_6) δ : 1.70-3.30 (10H, br m), 6.60 (4H, d, J = 8.9 Hz), 7.00 (4H, d, J = 8.9 Hz) 9.63 (2H, s)

HRMS Calcd for $C_{14}H_{20}B_{10}O_2$ 328.2466, Found 328.2480

Anal. Calcd for $C_{14}H_{20}B_{10}O_2$: C, 51.20; H, 6.14. Found C, 50.89; H, 6.17.

Example 8

O-Methyl-BE100 (500 mg, 2.00mmol) was dissolved in benzene/diethyl ether (2:1, 15 ml), 1.54M n-butyl lithium/hexane solution (1.56 ml, 2.40 mmol) was added dropwise at 0℃ under argon atmosphere, then stirred at room temperature for 30 min. The mixture was cooled to 0℃, methyl chloroformate (227 mg, 2.40 mmol) was added dropwise, and stirred at room temperature for 3h. The reaction was quenched by the addition of water, and the mixture was extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=50/1) to give 1-methoxycarbonyl-12-(4- methoxyphenyl-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE110) (91%).

Colorless needles

^{1}H-NMR ($CDCl_3$) δ :1.60-3.40 (10 H, br m), 3.65 (3H, s), 3.74 (3H, s), 6.68 (2H, d, J = 9.1 Hz), 7.08 (2H, d, J = 9.1 Hz).

O-Methyl-BE110 was demethylated by a similar procedure that used for BE160. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=6/1) to give 1-methoxycarbonyl-12-(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE110)(99%).

Colorless prisms (dichloromethane/hexane)

m.p. : 178-179℃

^{1}H-NMR ($CDCl_3$) δ :1.60-3.40 (10H, br m), 3.65 (3H, s), 4.84 (1H, br), 6.61 (2H, d, J = 9.0 Hz), 7.04 (2H, d, J = 9.0 Hz)

HRMS Calcd for $C_{10}H_{18}B_{10}O_3$ 294.2259, Found 294.2265

Anal. Calcd for $C_{10}H_{18}B_{10}O_3$: C, 40.81; H, 6.16. Found C, 40.66; H, 6.18.

To a suspension of lithium aluminum hydride (25.8 mg, 0.680 mmol) in THF (3 ml), O-methyl-BE110 (150 mg, 0.486 mmol) in THF (2 ml) was added dropwise at 0℃, then stirred at room temperature for 2.5 h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated to give 1-hydroxymethyl-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE120) (99%).
Colorless needles ; ^{1}H-NMR ($CDCl_3$) δ : 1.50-3.30 (10H, br m), 3.54 (2H, s), 3.74 (3H, s), 6.68 (2H, d, J = 9.2 Hz), 7.11 (2H, d, J = 9.2 Hz).

O-Methyl-BE120 was demethylated by a similar procedure that used for BE160. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=4/1) to give 1-hydroxymethyl-12-(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE120) (100%).
Colorless needles (dichloromethane/hexane) ; m.p. : 184-185℃ ; ^{1}H-NMR ($CDCl_3$) δ : 1.50-3.30 (10H, br m), 3.54 (2H, s), 4.87 (1H, br), 6.61 (2H, d, J = 8.9 Hz), 7.06 (2H, d, J = 8.9 Hz) ; HRMS Calcd for $C_9H_{18}B_{10}O_2$ 266.2310, Found 266.2310
Anal. Calcd for $C_9H_{18}B_{10}O_2$: C, 40.59; H, 6.81. Found C, 40.30; H, 6.59.

Example 9

O-Methyl-BE110 (260 mg, 0.843 mmol) was dissolved in THF (3ml), 1N potassium hydroxide (4.22 ml) was added, and stirred at room temperature for 17h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water and then brine, dried over sodium sulfate and concentrated to give 1-hydroxycarbonyl-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE130) (quantitatively).
Colorless needles ; ^{1}H-NMR (DMSO-d_6) δ :1.60-3.40 (10H, br m), 3.69 (3H, s), 6.78 (2H, d, J = 9.1 Hz), 7.08 (2H, d, J = 9.1 Hz), 14.06 (1H, br).

O-Methyl-BE130 was demethylated by a similar procedure that used for BE160 to give 1-hydroxycarbonyl-12-(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodeca-

borane (BE130).

Colorless needles (ethyl acetate/dichloromethane/hexane) ; m.p. : 249-252℃ ; ^{1}H-NMR (DMSO-d_6) δ :1.60-3.40 (10H, br m), 6.57 (2H, d, J = 8.8 Hz), 6.94 (2H, d, J = 8.8 Hz), 9.58 (1H, s).

Anal. Calcd for $C_9H_{16}B_{10}O_3$: C, 38.56; H, 5.75. Found C, 38.39; H, 5.82.

A mixture of BE130 (50 mg, 0.170 mmol), triethylamine (51.6 mg, 0.510 mmol), DMAP (2.1 mg, 0.0172 mmol), and DPPA (70.1 mg, 0.254 mmol) in t-butanol (3 ml) was refluxed for 24h. The mixture was concentrated, and the residue was dissolved in ethyl acetate. The product was washed with water then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=20/1) to give 1-tert-butoxycarbonyl-amino-12-(4-methoxyphenyl)-1,12 -dicarba-*closo*-dodecaborane (41%).

Colorless needles ; ^{1}H-NMR ($CDCl_3$) δ :1.39 (9H, s), 1.60-3.40 (10H, br m), 3.73 (3H, s), 4.89 (1H,s), 6.67 (2H, d, J = 9.0 Hz), 7.11 (2H, d, J = 9.0 Hz).

The Boc protected product obtained above (62 mg, 0.170 mmol) was dissolved in dichloromethane (2 ml), TFA (0.4 ml) was added, and stirred at room temperature for 2.5h. The reaction was quenched by the addition of saturated sodium hydrogen carbonate solution, and the mixture was extracted with dichloromethane. The organic layer was washed with brine, dried over sodium sulfate and concentrated to give 1-amino-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE140) (100%).

Colorless needles

^{1}H-NMR ($CDCl_3$) δ :1.50-3.30 (10H, br m), 3.73 (3H, s), 6.67 (2H, d, J = 9.0 Hz), 7.11 (2H, d, J = 9.0 Hz).

O-Methyl-BE140 was demethylated by a similar procedure that used for BE160. The mixture was poured into cool saturated sodium hydrogencarbonate solution, and extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) to give 1-amino-12-

(4-hydroxyphenyl)-1,12 -dicarba-*closo*-dodecaborane (BE140) (100%).

Colorless needles (dichloromethane/hexane)

m.p. : 169-171℃

^{1}H-NMR ($CDCl_3$) δ : 1.50-3.30 (10H, br m), 2.05 (2H, br s), 4.81 (1H, s), 6.59 (2H, d, J = 9.0 Hz), 7.06 (2H, d, J = 9.0 Hz)

HRMS Calcd for $C_8H_{17}B_{10}NO$ 251.2313, Found 251.2299

Example 10

O-Methyl-BE100 (500 mg, 2.00 mmol) was dissolved in diethyl ether (5 ml), 1.54M n-butyl lithium/hexane solution (1.56 ml, 2.40 mmol) was added dropwise at 0℃ under argon atmosphere, and then stirred at room temperature for 2h. Acetyl chloride (236 mg, 3.01 mmol) was dissolved in THF (1 ml) and added dropwise under cooling with dry ice/acetone bath, then stirred at room temperature for 18h. The reaction was quenched by the addition of water, and the mixture was extracted with ethyl acetate. The organic layer was washed with brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane→hexane/ethyl acetate=30/1) to give 1-acetyl-12-(4-methoxy)-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE150) (12%) and the starting material (67%).

Colorless needles

^{1}H-NMR ($CDCl_3$) δ :1.60-3.40 (10H, br m), 2.11 (3H, s), 3.74 (3H, s), 6.68 (2H, d, J = 9.1 Hz), 7.09 (2H, d, J = 9.1 Hz).

O-Methyl-BE150 was demethylated by a similar procedure that used for BE160. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) to give 1-acetyl-12-(4-hydroxyphenyl) -1,12-dicarba-*closo*-dodecaborane (BE150) (19%).

Colorless needles (dichloromethane/hexane)

^{1}H-NMR ($CDCl_3$) δ :1.50-3.30 (10H, br m), 2.11 (3H, s), 4.85 (1H, s), 6.62 (2H, d, J = 8.9 Hz), 7.05 (2H, d, J = 8.9 Hz).

O-Methyl-BE150 (70 mg, 0.239 mmol) was suspended in ethanol (3 ml), sodium

boron hydride (4.52 mg, 0.119 mmol) was added, and stirred at room temperature for 30 min. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=10/1) to give 1-hydroxyethyl-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE121) (78%).

Colorless needles

^{1}H-NMR ($CDCl_3$) δ : 1.11 (3H, d, J = 6.4 Hz), 1.50-3.30 (10H, br m), 3.74 (1H, q, J = 6.4 Hz), 3.74 (3H, s), 6.68 (2H, d, J = 9.1 Hz), 7.11 (2H, d, J = 9.1 Hz).

Anal. Calcd for $C_{10}H_{20}B_{10}O_2$: C, 42.84; H, 7.14. Found C, 42.93; H, 7.50.

O-Methyl-BE121 was demethylated by a similar procedure that used for BE160. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=5/1) to give 1-hydroxyethyl-12-(4 -hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE121) (94%).

Colorless flakes (dichloromethane/hexane)

m.p. : 173-174℃

^{1}H-NMR ($CDCl_3$) δ :1.11 (3H, d, J = 6.4 Hz), 1.50-3.30 (10H, br m), 3.74 (1H, q, J = 6.4 Hz), 4.84 (1H, br), 6.61 (2H, d, J = 9.0 Hz), 7.07 (2H, d, J = 9.1 Hz)

HRMS Calcd for $C_{10}H_{20}B_{10}O_2$ 280.2466, Found 280.2466

Example 11

1,7-Dicarba-*closo*-dodecaborane (3.5 g, 24.3 mmol) was dissolved in DME, 1.54 M n-butyl lithium/hexane solution (16.6 ml, 25.6 mmol) was added dropwise at 0℃ under argon atmosphere. The mixture was stirred at room temperature for 30 min, cuprous chloride (3.13 g, 31.6 mmol) was added in one portion, and further stirred at room temperature for 1h. Then, pyridine (14.7 ml, 183 mmol) was added, 4-iodoanisole (5.97 g, 25.5 mmol) was added in one portion, and heated at 100℃ for 48h. After cooling, the mixture was diluted with diethyl ether, stirred at room temperature for 3h, and insoluble substance was separated by filtration with Celite. The filtrate was washed with 2N hydrochloric acid, $Na_2S_2O_3$ solution, water, and brine

in order, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : hexane→hexane/ethyl acetate=30/1) to give 1-(4-methoxyphenyl)-1,7-dicarba-*closo*-dodecaborane (O-methyl-BE200) (41%) and 1,7-bis(4-methoxyphenyl)-1,7-dicarba-*closo*-dodecaborane (O, O'-dimethyl-BE260) (17%).

O-methyl-BE200

Colorless needles

^{1}H-NMR ($CDCl_3$) δ :1.50-3.70 (10H, br m), 3.04 (1H, br s), 3.77 (3H, s), 6.76 (2H, d, J = 9.2 Hz), 7.33 (2H, d, J = 9.2 Hz).

O,O'-dimethyl-BE260

Colorless needles

^{1}H-NMR ($CDCl_3$) δ :1.50-3.70 (10H, br m), 3.78 (6H, s), 6.77 (4H, d, J = 9.0 Hz), 7.37 (4H, d, J = 9.0 Hz).

O-Methyl-BE200 was demethylated by a similar procedure that used for BE100. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=10/1) to give 1-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE200) (92%).

Colorless needles (dichloromethane/hexane)

m.p. : 180-181℃

^{1}H-NMR ($CDCl_3$) δ :1.50-3.70 (10H, br m), 3.04 (1H, br s), 4.81 (1H, s), 6.69 (2H, d, J = 8.9 Hz), 7.28 (2H, d, J = 8.9 Hz).

Anal. Calcd for $C_8H_{16}B_{10}O$: C, 40.66; H, 6.82. Found C, 40.52; H, 6.68.

O, O'-Dimethyl-BE260 was demethylated by a similar procedure that used for BE160. The product was purified by silica gel flash column chromatography (eluent : hexane/ethyl acetate=3/1) to give 1,7-bis(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE260) (85%).

Colorless needles (ethyl acetate/hexane)

m.p. : 198-199℃

^{1}H-NMR (DMSO-d_6) δ :1.50-3.80 (10H, br m), 6.68 (4H, d, J = 8.9 Hz), 7.26 (4H, d, J = 8.9 Hz), 9.73 (2H, s)

Anal. Calcd for $C_{14}H_{20}B_{10}O_2$: C, 51.20; H, 6.14. Found C, 51.14; H, 6.07.

Example 12

2,3,4,5,6,7,8,9,10,11-Decamethyl-1,12-dicarba-*closo*-dodecaborane (1.36 g, 4.78 mmol) was dissolved in dry THF(100 ml), methyl lithium (1.02 M, ether solution, 42.1 ml, 48.0 mmol) was added dropwise at 0℃ in 10 min under argon atmosphere, then stirred at room temperature for 5h. The mixture was poured into dry ice, 2N hydrochloric acid was added to acidify, and the mixture was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate, and the solvent was evaporated. The residue was purified by silica gel column chromatography (eluent : n-hexane, 50% chloroform/n-hexane, chloroform). The starting material (312.3 mg, 22.9%) was recovered from n-hexane eluent, and white solid of 2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carboxylic acid (1.20 g, 76.4%) was obtained from chloroform eluent.

Colorless prisms (benzene)

m.p. : 224-225℃

Anal. Calcd for $C_{13}B_{10}H_{32}O_2$: C, 47.53; H, 9.82. Found C, 47.33; H, 9.59. ^{1}H-NMR ($CDCl_3$, 400MHz) δ 2.21 (1H, s, CH), 0.13, 0.07 (each 15H, s, BCH_3). ^{11}B-NMR ($CDCl_3$, 160.35 MHz) δ -7.98, -9.49 (each 5B, s, BCH_3).

Thionyl chloride (6 ml) and dry DMF (0.06 ml) were added to 2,3,4,5,6,7,8,9, 10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carboxylic acid (60.1 mg, 0.18 mmol) under argon atmosphere, and heated at 90℃ for 5h. Excess amount of thionyl chloride was evaporated under reduced pressure, water was added to the residue, and the residue was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate, and the solvent was evaporated. The residue was purified by silica gel column chromatography (eluent : n-hexane) to give white solid of 2,3,4,5,6,7,8,9, 10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonyl chloride (59.5 mg, 93.7%).

Colorless prisms (methanol)

m.p. : 183-184℃

Anal. Calcd for $C_{13}B_{10}H_{31}OCl$: C, 45.00; H, 9.01. Found C, 45.00; H, 8.78. ^{1}H-NMR

($CDCl_3$, 400MHz) δ 2.29 (1H, s, CH), 0.22, 0.10 (each 15H, s, BCH_3). ^{11}B-NMR ($CDCl_3$, 160.35 MHz) δ -7.64, -9.32 (each 5B, s, BCH_3).

2,3,4,5,6,7,8,9,10,11-Decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonyl chloride (500 mg, 1.44 mmol) was dissolved in dry DMF (15 ml) under argon atmosphere, sodium azide (140.4 mg, 2.16 mmol) was added at 0℃, and stirred at 30℃ for 30 min. The mixture was poured into water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate, and the solvent was evaporated. The residue was purified by silica gel column chromatography (eluent : n-hexane) to give white solid of 2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonyl azide (487.1 mg, 95.6%)

Colorless flakes (ethanol-dichloromethane)

m.p. : 157-158℃

^1H-NMR ($CDCl_3$, 400MHz) δ 2.23 (1H, s, CH), 0.16, 0.07 (each 15H, s, BCH_3).

2,3,4,5,6,7,8,9,10,11-Decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonyl azide (487.1 mg, 1.38 mmol) was dissolved in dry toluene (50 ml) under argon atmosphere, and heated at 100℃ for 2h. The mixture was poured into water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and the solvent was evaporated. The residue was purified by silica gel column chromatography (eluent : n-hexane) to give white solid of 2,3,4,5,6,7,8,9,10,11- decamethyl-1,12-dicarba-*closo*-dodecaboran-1-yl isocyanate (439.4 mg, 98.0%).

Colorless prisms (acetonitrile-dichloromethane)

m.p. : 162-163℃

Anal. Calcd for $C_{13}B_{10}H_{31}ON$: C, 47.97; H, 9.60; N, 4.30. Found C, 47.96; H, 9.30; N, 4.24.

^1H-NMR ($CDCl_3$, 400MHz) δ 1.92 (1H, s, CH), 0.08, 0.03 (each 15H, s, BCH_3).

^{11}B-NMR ($CDCl_3$, 160.35MHz) δ -8.30, -11.20 (each 5B, s, BCH_3).

2,3,4,5,6,7,8,9,10,11-Decamethyl-1,12-dicarba-*closo*-dodecaboran-1-yl-isocyanate (337.4 mg, 1.04 mmol) was dissolved in methanol (30 ml), and heated at

80℃ for 24h. The solvent was evaporated under reduced pressure to give white solid of 1-methoxycarbonylamino-2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane (367.4 mg, 99.1%).

Colorless prisms (methanol)

m.p. : 184℃

Anal. Calcd for $C_{14}B_{10}H_{35}O_2N$: C, 47.03; H, 9.87; N, 3.92. Found C, 46.76; H, 9.68; N, 3.80.

^1H NMR ($CDCl_3$, 400MHz) δ 4.36 (1H, s), 3.54(3H, s), 1.96 (1H, s, CH), 0.09, 0.07 (each 15H, s, BCH_3).

1-Methoxy carbonylamino-2,3,4,5,6,7,8,9,10,11-decamethy -1,12-dicarba-*closo*-dodecaborane (266.2 mg, 0.745 mmol) was dissolved in methanol (30 ml), 2N potassium hydroxide solution (3.5 ml) was added, and heated at 80℃ for 3 days. The mixture was poured into water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate, and the solvent was removed to give white powders of 1-amino-2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane (218.2 mg, 97.8%)

Colorless flakes (methanol)

m.p. : 170℃

^1H NMR ($CDCl_3$, 400MHz) δ 1.83 (1H, s, CH), 1.16 (2H, br s, NH_2), 0.06, -0.08 (each 15H, s, BCH_3).

2,3,4,5,6,7,8,9,10,11-Decamethyl-1,12-dicarba-*closo*-dodecaborane-1 -carbonyl chloride (58.9 mg, 0.17 mmol) was dissolved in 1,2-dichlorobenzene (1 ml) under argon atmosphere, ethyl 4-aminobenzoate (140.4 mg, 0.85 mmol) was added, and heated at 180℃ for 24h. The solvent was removed under reduced pressure, 2N hydrochloric acid was added, and the residue was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and the solvent was evaporated. The residue was purified by silica gel column chromatography (eluent : 20% ethyl acetate/n-hexane) to give white solid of ethyl 4-(2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonylamino)benzoate (89.1 mg, quant.).

Colorless flakes (dichloromethane-hexane)

m.p. : 135-137℃

Anal. Calcd for $C_{22}B_{10}H_{41}O_3N$: C, 55.55; H, 8.69; N, 2.95. Found C, 55.34; H, 8.41; N, 3.02.

^1H NMR ($CDCl_3$, 400MHz) δ 7.96 (2H, d, J = 8.8 Hz), 7.41 (2H, d, J = 8.8 Hz), 7.09 (1H, br s, NH), 4.35 (2H, q, J = 7.1 Hz), 2.27 (1H, s, CH), 1.38 (3H, t, J = 7.1 Hz), 0.27, 0.12 (each 15H, s, BCH_3)

Ethyl 4-(2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonylamino) ethyl benzoate (56.2 mg, 0.118 mmol) was dissolved in ethanol (5 ml), 1N potassium hydroxide solution (1 ml) was added, and heated at 80℃ for 1h. 2N hydrochloric acid was added, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over magnesium sulfate and the solvent was evaporated to give white solid of 4-(2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonylamino) benzoic acid (60.2 mg, quant.)(BR630).

Colorless needles (dichloromethane hexane)

m.p. : 285-286℃

Anal. Calcd for $C_{20}B_{10}H_{37}O_3N$: C, 53.67; H, 8.33; N, 3.13. Found C, 53.68; H, 8.22; N, 3.01.

^1H NMR ($CDCl_3$, 400MHz) δ 8.01 (2H, d, J = 9.0 Hz), 7.45 (2H, d, J = 8.8 Hz), 7.13 (1H, br s, NH), 2.27 (1H, s, CH), 0.27, 0.12 (each 15H, s, BCH_3).

1-Amino-2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*- dodecaborane (50.0 mg, 0.167 mmol) was dissolved in 1,2-dichlorobenzene (1 ml) under argon atmosphere, terephthalic acid monomethyl ester chloride (49.8 mg, 0.251 mmol) and anhydrous pyridine (0.2 ml) were added, and heated at 180℃ for 18h. After the solvent was removed under reduced pressure, 2N hydrochloric acid was added to the residue, and extracted with ethyl acetate. The organic layer was washed with saturated sodium hydrogencarbonate solution then saturated brine, dried over magnesium sulfate and the solvent was evaporated. The residue was purified by silica gel column chromatography (eluent : 5% ethyl acetate/n-hexane) to give white

solid of methyl 4-(2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaboran-1-amino carbonyl)benzoate (40.5 mg, 52.5%). The compound (40.5 mg, 0.088 mmol) was dissolved in methanol (5 ml), 1N potassium hydroxide solution (1 ml) was added, and heated at 80℃ for 1h. 2N hydrochloric acid was added, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over magnesium sulfate and the solvent was evaporated to give white solid of 4-(2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaborane-1-carbonylamino) benzoic acid (BR635)(39.7 mg, quant.).

Colorless flakes (ethyl acetate-hexane)

m.p. : 259℃

Anal. Calcd for $C_{20}B_{10}H_{37}O_3N$: C, 53.67; H, 8.33; N, 3.13. Found C, 53.38; H, 8.10; N, 2.99.

^{1}H NMR ($CDCl_3$, 400MHz) δ 8.12 (2H, d, J = 8.3 Hz), 7.66 (2H, d, J = 8.3 Hz), 5.60 (1H, s, NH), 2.04 (1H, s, CH), 0.18, 0.11 (each 15H, s, BCH_3)

A mixture of 2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaboran-1-yl-isocyanate (40.0 mg, 0.123 mmol) and ethyl 4-aminobenzoate (20.3 mg, 0.123 mmol) was heated at 180℃ for 24h under argon atmosphere. A crude product was purified by silica gel column chromatography (eluent : 20% ethyl acetate/n-hexane) to give white solid of (2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaboran-1-yl)(4-methoxycarbonylphenyl)urea (30.7 mg, 50.9%). The compound (30.7 mg, 0.063 mmol) was dissolved in ethanol (5 ml), 1N potassium hydroxide solution (1 ml) was added, and heated at 80℃ for 1h. 2N hydrochloric acid was added, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over magnesium sulfate and the solvent was evaporated to give white solid of (2,3,4,5,6,7,8,9,10,11-decamethyl-1,12-dicarba-*closo*-dodecaboran-1-yl)(4-carboxyphenyl)urea (BR638)(28.5 mg, 98.6%).

Colorless flakes (methanol)

m.p. : >300 ℃; Anal. Calcd for $C_{20}B_{10}H_{38}O_3N_2$: C, 51.92; H, 8.28; N, 6.06. Found C, 51.63; H, 8.09; N, 5.77.

^{1}H NMR (DMSO-d_6, 400MHz) δ 9.49 (1H, s, NH) 7.92 (2H, d, J = 8.8 Hz), 7.48 (2H, d, J = 8.8 Hz), 5.57 (1H, s, NH), 2.77 (1H, s, CH), 0.20, 0.14 (each 15H, s, BCH_3).

Example 13

To a mixture of methyl 4-(4-bromophenoxy)benzoate (2.0 g, 6.51 mmol), ethynyltrimethylsilane (1.60g, 16.2 mmol), $(PPh_3)_2PdCl_2$ (182 mg, 0.259 mmol), and CuI (24.8 mg, 0.130 mmol) in THF (30 ml), diisopropylamine (1.38 g, 13.7 mmol) was added dropwise under argon atmosphere. After the mixture was stirred at 50℃ for 24h, the mixture was then heated to reflux for 6h. Water was added to the mixture after cooling, insoluble substance was filtered with Celite, and the filtrate was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=30/1) to give methyl 4-(4-trimethylsilylethynylphenoxy)benzoate (63%).

^{1}H-NMR ($CDCl_3$) δ 0.25 (9 H, s), 3.90 (3 H, s), 6.97 (2 H, d, J = 8.8 Hz), 6.99 (2 H, d, J = 9.0 Hz), 7.48 (2 H, d, J = 8.8 Hz), 8.01 (2 H, d, J = 9.0 Hz).

To a solution of the methyl benzoate described above (1.28 g, 3.95 mmol) in methanol (20 ml), potassium carbonate (546 mg, 3.95 mmol) was added and stirred at room temperature for 1.5h. After the mixture was concentrated, water was added and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=10/1) to give methyl 4-(4-ethynylphenoxy)benzoate (89%).

^{1}H-NMR ($CDCl_3$) δ 3.06 (1 H, s), 3.91 (3 H, s), 6.99 (2 H, d, J =8.8 Hz), 7.01 (2 H, d, J = 8.8 Hz), 7.50 (2 H, d, J =8.8 Hz), 8.02 (2 H, d, J = 8.8 Hz).

A solution of methyl 4-(4-ethynylphenoxy)benzoate (850 mg, 3.37 mmol) and decaborane (14)(412 mg, 3.37 mmol) in acetonitrile (2.5 ml)-benzene (25 ml) was heated to reflux for 36h under argon atmosphere. The mixture was concentrated, and the residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=10/1) to give methyl 4-[4-(1,2-dicarba-*closo*-dodecaboran-1-yl)phenoxy]-benzoate (66%).

^{1}H-NMR ($CDCl_3$) δ (10 H, br m), 3.91 (4 H, s), 6.97 (2 H, d, J =8.9 Hz), 7.02 (2 H, d, J =

8.9 Hz), 7.49 (2 H, d, J =8.9 Hz), 8.04 (2 H, d, J = 8.9 Hz).

A solution of methyl 4-(4-ethynylphenoxy)benzoate (150 mg, 0.405 mmol) in DMF (3 ml) was added dropwise to DMF suspension (1 ml) of 60% sodium hydride (19.4 mg, 0.485 mmol), and stirred at room temperature for 5 min. DMF solution (1 ml) of 1-iodopropane (103 mg, 0.606 mmol) was added dropwise, and stirred at room temperature for 1h. The reaction was quenched by the addition of 2N hydrochloric acid, and the mixture was extracted with diethyl ether. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=10/1) to give methyl 4-[4-(2 -n-propyl-1,2 -dicarba-*closo*-dodecaboran-1-yl)-phenoxy]benzoate (44%).

^{1}H-NMR ($CDCl_3$) δ 0.77 (3 H, t, J = 7.3 Hz), 1.40-3.40 (10 H, br m), 1.43 (2 H, m), 1.75 (2 H, m), 3.92 (3 H, s), 7.01 (2 H, d, J =9.0 Hz), 7.06 (2 H, d, J = 9.0 Hz), 7.61 (2 H, d, J = 9.0 Hz), 8.06 (2 H, d, J = 9.0 Hz).

To a solution of the benzoate described above (55 mg, 0.133 mmol) in water (1.5 ml)-dioxane (5 ml), concentrated sulfuric acid (1 ml) was added and stirred at 100℃ for 24h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated to give 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenoxy]-benzoic acid (BR503)(95%)

Colorless plates (ethyl acetate/n-hexane)

m.p.

^{1}H-NMR (DMSO-d_6) δ 1.40-3.80 (10 H, br m), 2.18 (6 H, s), 2.59 (2 H, t, J = 5.8 Hz), 4.02 (2 H, t, J = 5.8 Hz), 6.69 (2 H, d, J = 8.8 Hz), 6.88 (2 H, d, J = 8.8 Hz), 7.27 (2 H, d, J = 8.8 Hz) 7.37 (2 H, d, J = 8.8 Hz), 9.74 (1 H, s)

Anal. Calcd for $C_{18}H_{29}B_{10}NO_2$: C, 54.11; H, 7.32; N, 3.51. Found C, 53.84; H, 7.14; N, 3.21.

To a mixture of methyl 4-(4-bromobenzoyl)benzoate (1.20 g, 3.76 mmol), ethynyltrimethylsilane (554 mg, 5.66 mmol), $(PPh_3)_2PdCl_2$(106 mg, 0.151 mmol), CuI

(14.3 mg, 0.075 mmol) in THF (30 ml), diisopropyl amine (799 mg, 7.92 mmol) was added dropwise under argon atmosphere. The mixture was stirred at 50℃ for 4h. Water was added to the mixture after cooling, and the mixture was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=10/1) to give methyl 4-(4-trimethyl-silylethynylbenzoyl)benzoate (83%).

^{1}H-NMR ($CDCl_3$) δ 0.28 (9 H, s), 3.97 (3 H, s), 7.57 (2 H, d, J = 8.6 Hz), 7.74 (2 H, d, J = 8.6 Hz), 7.81 (2 H, d, J = 8.6 Hz), 8,15 (2 H, d, J = 8.6 Hz).

To a solution of this compound (1.00 g, 2.97 mmol) in methanol (25 ml)/dichloromethane (2.5 ml), potassium carbonate (411 mg, 2.97 mmol) was added and stirred at room temperature for 1h. Water was added after the mixture was concentrated, and the mixture was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated to give methyl 4-(4-ethynylbenzoyl)benzoate (100%).

^{1}H-NMR ($CDCl_3$) δ 3.27 (1 H, s), 3.97 (3 H, s), 7.61 (2 H, d, J =8.6 Hz), 7.76 (2 H, d, J = 8.6 Hz), 7.82 (2 H, d, J =8.6 Hz), 8.15 (2 H, d, J = 8.6 Hz).

A solution of methyl 4-(4-ethynyl benzoyl)benzoate (780 mg, 2.95 mmol) and decaborane (14)(361 mg, 2.95 mmol) in acetonitrile (2.5 ml)/benzene (25 ml) was heated to reflux for 24h under argon atmosphere. The mixture was concentrated, and the residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=10/1) to give methyl 4-[4-(1,2-dicarba-*closo*-dodecaboran-1-yl)benzoyl]-benzoate (58%).

^{1}H-NMR ($CDCl_3$) δ 1.60-3.40 (10 H, br m), 3.97 (3 H, s), 4.03 (1 H, br s), 7.61 (2 H, d, J =8.5 Hz), 7.76 (2 H, d, J = 8.5 Hz), 7.82 (2 H, d, J =8.2 Hz), 8.16 (2 H, d, J = 8.2 Hz).

60% NaH (43.9 mg, 1.10 mmol) was added at 0℃ to a solution of methyl 4-[4-(1,2-dicarba-*closo*-dodecaboran-1-yl) benzoyl]benzoate (350 mg, 0.915 mmol) and propyl iodide (233 mg, 1.37 mmol) in DMF (15 ml), and stirred at room temperature for 1h. The reaction was quenched by the addition of 2N hydrochloric acid, and the

mixture was extracted with diethyl ether. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=20/1) to give methyl 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)benzoyl benzoate (58%).

^{1}H-NMR ($CDCl_3$) δ 0.75 (3 H, t, J = 7.3 Hz), 1.60-3.80 (10 H, br m), 1.44 (2 H, m), 1.75 (2 H, m), 3.98 (3 H, s), 7.77 (2 H, d, J =8.9 Hz), 7.81 (2 H, d, J = 8.9 Hz), 7.88 (2 H, d, J = 8.6 Hz), 8.17 (2 H, d, J = 8.6 Hz);

HRMS Calcd for $C_{20}H_{28}B_{10}O_3$ 424.3042, Found 424.3039

To a solution of 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)benzoyl]-methyl benzoate (50 mg, 0.118 mmol) in water (1.5 ml)/dioxane (5 ml), concentrated sulfuric acid (1 ml) was added and stirred at 100℃ for 24h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated to give 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)benzoyl]benzoic acid (BR513).

Colorless needles (n-hexane/ethyl acetate)

m.p. : 236-237℃

^{1}H-NMR (DMSO-d_6) δ 0.70 (3 H, t, J = 7.3 Hz), 1.36 (2 H, m), 1.40-3.40 (10 H, br m), 1.83 (2 H, m), 7.83 (2 H, d, J =8.5 Hz), 7.84 (2 H, d, J = 8.2 Hz), 7.91 (2 H, d, J = 8.5 Hz), 8.10 (2 H, d, J = 8.2 Hz), 13.33 (1 H, br).

HRMS Calc for $C_{20}H_{28}B_{10}NO_2$ 408.3092, Found 408.3084

To a solution of methyl 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)-benzoyl]benzoate (75 mg, 0.177 mmol) in THF (2 ml), 2.4 mmol/1 g trimethyl-triphenylphosphoniumbromide-sodium amide (370 mg, 0.888 mmol) was added and stirred for 2h under argon atmosphere. 2N hydrochloric acid was added at 0℃, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=30/1) to give methyl 4-[1-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)-phenyl]ethenyl]benzoate (25%).

^{1}H-NMR ($CDCl_3$) δ 0.76 (3 H, t, J = 7.2 Hz), 1.44 (2 H, m), 1.50-3.60 (10 H, br m), 1.76 (2 H, m), 3.93 (3 H, s), 5.60 (1 H, s), 5.62 (1 H, s), 7.32 (2 H, d, J =8.6 Hz), 7.37 (2 H, d, J = 8.4 Hz), 7.59 (2 H, d, J = 8.6 Hz), 8.02 (2 H, d, J = 8.4 Hz)

HRMS Calcd for $C_{21}H_{30}B_{10}O_2$ 422.3249, Found 422.3278

To a solution of methyl 4-[1-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)phenyl]ethenyl]benzoate (17 mg, 0.0402 mmol) in water (1.5 ml)/ dioxane (5 ml), concentrated sulfuric acid (1 ml) was added and stirred at 100℃ for 24h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: n-hexane/ethyl acetate=2/1) to give 4-[1-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl) phenyl]ethenyl] benzoic acid (64%).

Colorless needles (n-hexane/ethyl acetate)

m.p. : 152-154℃

^{1}H-NMR (DMSO-d_6) δ 0.71 (3 H, t, J = 7.3 Hz), 1.35 (2 H, m), 1.40-3.40 (10 H, br m), 1.81 (2 H, m), 5.68 (1 H, s), 5.71 (1 H, s)7.38 (2 H, d, J =8.5 Hz), 7.40 (2 H, d, J = 8.5 Hz), 7.70 (2 H, d, J = 8.5 Hz), 7.94 (2 H, d, J = 8.5 Hz), 12.98 (1 H, br).

To a solution of methyl 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)benzoyl]benzoate (50 mg, 0.118 mmol) in THF (1 ml)/dichloromethane (1 ml), trimethylsilane (274 mg, 2.36 mmol) was added and stirred at 50 ℃ for 5h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: n-hexane/ethyl acetate=20/1) to give methyl 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodeca-boran-1-yl)benzyl]benzoate (90%).

^{1}H-NMR ($CDCl_3$) δ 0.72 (3 H, t, J = 7.3 Hz), 1.40 (2 H, m), 1.50-3.60 (10 H, br m), 1.71 (2 H, m), 3.90 (3 H, s), 4.04 (2 H, s), 7.17 (2 H, d, J =8.5 Hz), 7.24 (2 H, d, J = 8.5 Hz), 7.53 (2 H, d, J = 8.5 Hz), 7.98 (2 H, d, J = 8.5 Hz)

HRMS Calcd for $C_{20}H_{30}B_{10}O_2$ 410.3249, Found 410.3220

To a solution of methyl 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl) benzyl]benzoate (40 mg, 0.0974 mmol) in water (1.5 ml)/dioxane (5 ml), concentrated sulfuric acid (1 ml) was added and stirred at 100℃ for 24h. The mixture was poured in ice water, and extracted with ethyl acetate. The organic layer was washed with water and saturated brine, dried over sodium sulfate and concentrated to give 4-[4-(2-n-propyl-1,2-dicarba-*closo*-dodecaboran-1-yl)benzyl]benzoic acid (BR533) (100%).

Colorless prisms (n-hexane/ethyl acetate)

m.p. : 205-206℃

^{1}H-NMR (DMSO-d_6) δ 0.66 (3 H, t, J = 7.4 Hz), 1.31 (2 H, m), 1.40-3.40 (10 H, br m) , 1.75 (2 H, m), 4.07 (2 H, s),7.33 (2 H, d, J =8.2 Hz), 7.34 (2 H, d, J = 8.2 Hz), 7.61 (2 H, d, J = 8.2 Hz), 7.86 (2 H, d, J = 8.2 Hz), 12.80 (1 H, br).

Anal. Calcd for $C_{19}H_{28}B_{10}O_2$: C, 57.55; H, 7.12. Found C, 57.31; H, 7.09.

Example 14

To a solution of O-methyl-BE100 (300 mg, 1.20 mmol) in benzene (2 ml) /diethyl ether (1 ml), 1.53 M n-buLi hexane solution (0.82 ml, 1.25 mmol) was added dropwise at 0℃ under argon atmosphere. After stirring at room temperature for 30min, a solution of benzoyl peroxide (145 mg, 0.601 mmol) in benzene(2 ml)/diethyl ether (1 ml) was added dropwise at 0℃. Then the mixture was stirred at room temperature for 2 h. The reaction was quenched by the addition of 10% hydrochloric acid solution and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: n-hexane/ethyl acetate=10/1) to give 1-hydroxy-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (O-methyl-BE119) (75%)

^{1}H-NMR ($CDCl_3$) d 1.60-3.40 (10 H, br m), 2.87 (1 H, s), 3.73 (3 H, s), 6.67 (2 H, d, J = 8.6 Hz), 7.12 (2 H, d, J = 8.6 Hz)

HRMS Calcd for $C_9H_{18}B_{10}O_2$ 266.2310, Found 266.2304

To a solution of O-methyl-BE119 (91 mg, 0.342 mmol) in dichloromethane (3 ml), 1M BBr_3 dichloromethane solution (0.855 ml) was added dropwise at −78℃.

Then the mixture was stirred at room temperature for 2h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated to give 1-hydroxy-12-(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE119) (100%).

Colorless needles (dichloromethane/n-hexane)

m.p. : 181-183℃

^{1}H-NMR ($CDCl_3$) d 1.50-3.40 (10 H, br m), 4.70 (1 H, br), 6.60 (2 H, d, J = 8.8 Hz), 7.07 (2 H, d, J = 8.8 Hz)

HRMS Calcd for $C_8H_{16}B_{10}O_2$ 252.2153, Found 252.2173

Anal. Calcd for $C_8H_{16}B_{10}O_2 \cdot 0.5H_2O$: C, 36.77; H, 6.56. Found C, 36.42; H, 6.57.

To a solution of O-methyl-BE100 (200 mg, 0.799 mmol) in benzene (5 ml)/diethylether (2.5 ml), 1.53M n-BuLi hexane solution (0.623 ml, 0.953 mmol) was added dropwise at 0℃ under argon atmosphere. After stirring at room temperature for 30min, 2-(2-bromoethoxy) tetrahydro-2H-pyran (231 mg, 1.20 mmol) was added dropwise at 0℃. Then, the mixture was stirred at room temperature for 15h. The reaction was quenched by the addition of water, and the mixture was extracted with diethyl ether. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/dichloromethane=2/1) to give 1-(4-methoxyphenyl)-12-(2-tetrahydropyranyloxyethyl)-1,12-dicarba-*closo*-dodecaborane (45%).

^{1}H-NMR ($CDCl_3$) d 1.45-1.82 (6 H, m), 1.50-3.20 (10 H, br m), 1.98 (2 H, t, J = 7.0 Hz), 3.17 (1 H, dt, J = 9.9, 7.6 Hz), 3.45-3.51 (1 H, m), 3.55 (1 H, dt, J = 10.1, 7.3 Hz), 3.73 (3 H, s), 3.80 (1 H, m), 4.49 (1 H, m), 6.67 (2 H, d, J = 9.2 Hz), 7.10 (2 H, d, J = 9.2 Hz).

p-Toluenesulfonic acid hydrate (5.6 mg, 0.0294 mmol) was added to a solution of 1-(4-methoxyphenyl)-12-(2-tetrahydropyranyloxyethyl)-1,12-dicarba-*closo*-dodecaborane (112 mg, 0.296 mmol) in methanol (3 ml) /dichloromethane (1 ml), and stirred at room temperature for 15h. The reaction was quenched by the addition of saturated sodium hydrogencarbonate solution, and the mixture was extracted with dichloromethane. The organic layer was washed with water then saturated brine,

dried over sodium sulfate and concentrated to give 1-(2-hydroxyethyl)-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane.

^{1}H-NMR ($CDCl_3$) d 1.50-3.30 (10 H, br m), 1.95 (2 H, t, J = 7.0 Hz) 3.48 (2 H, t, J = 7.0 Hz), 3.73 (3 H, s), 6.67 (2 H, d, J =9.0 Hz), 7.10 (2 H, d, J = 9.0 Hz).

To a solution of 1-(2-hydroxyethyl)-12-(4-(methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (80 mg, 0.272 mmol) in dichloromethane (3 ml), 1M BBr_3 dichloromethane solution (0.680 ml) was added dropwise at −78℃, then stirred at room temperature for 3h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: n-hexane/ethyl acetate=10/1) to give 1-(2-hydroxyethyl)-12-(4-(hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE122)(88%).

Colorless needles (dichloromethane/n-hexane)

m.p. : 180-181℃

^{1}H-NMR ($CDCl_3$) d 1.30 (1 H, t, J = 5.1 Hz), 1.50-3.30 (10 H, br m), 1.95 (2 H, t, J = 7.0 Hz) 3.48 (2 H, dt, J = 5.1, 7.0 Hz), 4.75 (1 H, s), 6.60 (2 H, d, J =9.0 Hz), 7.06 (2 H, d, J = 9.0 Hz)

HRMS Calcd for $C_{10}H_{20}B_{10}O_2$ 280.2466, Found 280.2462

Anal. Calcd for $C_{10}H_{20}B_{10}O_2$: C, 42.84; H, 7.19. Found C, 42.79; H, 7.46.

To a solution of O-methyl-BE100 (750 mg, 3.00 mmol) in benzene (10 ml)/diethyl ether (5 ml), 1.53 M n-BuLi hexane solution (2.35 ml, 3.60 mmol) was added dropwise at 0℃ under argon atmosphere. After stirring at 30℃ for 30 min, 2-(3-bromopropyloxy) tetrahydro-2H-pyran (746 mg, 3.60 mmol) was added dropwise at 0℃. Then the mixture was stirred at room temperature for 18h. The reaction was quenched by the addition of water, and the mixture was extracted with diethyl ether. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/dichloromethane) to give 1-(4-methoxyphenyl)-12-(3-tetrahydropyranyloxy-n-propyl)-1,12-dicarba-*closo*-dodecaborane (69%). To a methanol solution of this compound (705 mg, 1.80 mmol), p-toluene sulfonic acid hydrate (34.2 mg, 0.180 mmol)

was added, and stirred at room temperature for 15h. The reaction was quenched by the addition of saturated sodium hydrogencarbonate solution, and the mixture was extracted with dichloromethane. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated to give 1-(3-hydroxypropyl)-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (93%).
^{1}H-NMR ($CDCl_3$) d 1.17 (1 H, br s) 1.40-3.30 (10 H, br m), 1.46 (2 H, m), 1.78 (2 H, m) 3.50 (2 H, m), 3.73 (3 H, s), 6.67 (2 H, d, J =9.0 Hz), 7.10 (2 H, d, J = 9.0 Hz).

To a solution of 1-(3-hydroxypropyl)-12-(4-methoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (80 mg, 0.259 mmol) in dichloromethane (3 ml), 1M BBr_3 dichloromethane solution (0.648 ml) was added dropwise at −78℃. Then the mixture was stirred at room temperature for 3h. The mixture was poured into ice water and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: n-hexane/ethyl acetate=4/1) to give 1-(3-hydroxypropyl)-12-(4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE123) (92%).
Colorless needles (dichloromethane/n-hexane)
m.p. : 185-187℃
^{1}H-NMR ($CDCl_3$) d 1.10-3.30 (10 H, br m), 1.45 (2 H, m), 1.77 (2 H, m), 3.50 (2 H, t, J = 6.1 Hz), 4.70 (1 H, br s), 6.60 (2 H, d, J =8.8 Hz), 7.06 (2 H, d, J = 8.5 Hz)
Anal. Calcd for $C_{11}H_{22}B_{10}O_2$: C, 44.88; H, 7.53. Found C, 44.58; H, 7.32.

O-Methyl-BE200 was converted to 1-hydroxy-7-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE219) by a similar procedure that used for BE119.
Colorless needles (dichloromethane/n-hexane)
m.p. : 168-169℃
^{1}H-NMR ($CDCl_3$) d 1.40-4.00 (10 H, br m), 4.80 (1 H, br), 6.70 (2 H, d, J = 9.0 Hz), 7.28 (2 H, d, J = 9.0 Hz)
Anal. Calcd for $C_8H_{16}B_{10}O_2$: C, 38.08; H, 6.39. Found C, 37.84; H, 6.30.

O-Methyl-BE200 was converted to1-(2-hydroxyethyl)-7-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE222) by a similar procedure that used for BE122..

Colorless needles (dichloromethane/n-hexane)

m.p. : 156-157℃

^{1}H-NMR ($CDCl_3$) d 1.50-3.50 (10 H, br m), 2.28 (2 H, t, J =6.9 Hz) 3.67 (2 H, t, J = 6.9, Hz), 4.79 (1 H, s), 6.69 (2 H, d, J =8.9 Hz), 7.28 (2 H, d, J = 8.9 Hz)

HRMS Calcd for $C_{10}H_{20}B_{10}O_2$ 280.2466, Found 280.2470

Anal. Calcd for $C_{10}H_{20}B_{10}O_2$: C, 42.84; H, 7.19. Found C, 42.53; H, 6.75.

O-Methyl-BE200 was converted to 1-(3-hydroxypropyl)-7-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE323) by a similar procedure that used for BE123.

Colorless needles (dichloromethane/n-hexane)

m.p. : 157-158℃

^{1}H-NMR ($CDCl_3$) d 1.23 (1 H, t, J = 5.1 Hz), 1.40-3.80 (10 H, br m), 1.67 (2 H, m), 2.11 (2 H, m) 3.60 (2 H, dt, J = 5.1, 5.3 Hz), 4.81 (1 H, s), 6.68 (2 H, d, J =8.9 Hz), 7.28 (2 H, d, J = 8.9 Hz)

Anal. Calcd for $C_{11}H_{22}B_{10}O_2$: C, 44.88; H, 7.53. Found C, 44.61; H, 7.24.

1,12-Dicarba-*closo*-dodecaborane was converted to 1-(3-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE300) via O-methyl-BE300 by a similar procedure that used for BE100.

Colorless needles (dichloromethane/n-hexane)

m.p. : 163-164℃

^{1}H-NMR ($CDCl_3$) d 1.50-3.30 (10 H, br m), 2.78 (1 H, br s), 4.67 (1 H, s), 6.66-6.69 (2 H, m), 6.78 (1H,m), 7.03 (1 H, m)

Anal Calcd for $C_8H_{16}B_{10}O$: C, 40.66; H, 6.82. Found C, 40.36; H, 6.64.

O-Methyl-BE300 was converted to 1-hydroxy-12-(3-hydroxy phenyl)-1,12-dicarba-*closo*-dodecaborane(BE319) by a similar procedure that used for BE119.

Colorless needles (dichloromethane/n-hexane)

m.p. : 185-186℃

^{1}H-NMR ($CDCl_3$) d 1.50-3.40 (10 H, br m), 4.70 (1 H, br), 6.66-6.71 (2 H, m), 6.78 (1 H, br d) 7.02 (1 H, t, J = 8.0 Hz)

Anal. Calcd for $C_8H_{16}B_{10}O_2$: C, 38.08; H, 6.39. Found C, 38.31; H, 6.43.

O-Methyl-BE300 was converted to 1-(2-hydroxymethyl)-12-(3-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE320) by a similar procedure that used for BE120.

Colorless needles (dichloromethane/n-hexane)

m.p. : 134-135℃

^{1}H-NMR ($CDCl_3$) d 1.50-3.30 (10 H, br m), 1.58 (1 H, t, J = 7.3 Hz), 3.55 (2 H, d, J = 7.3 Hz), 4.70 (1 H, s), 6.67-6.69 (2 H, m), 6.77 (1 H, m), 7.03 (1 H, m)

Anal. Calcd for $C_9H_{18}B_{10}O_2 \cdot 0.2\ H_2O$: C, 40.04; H, 6.87. Found C, 39.98; H, 6.57.

O-Methyl-BE300 was converted to 1-(2-hydroxyethyl)-12-(3-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE322) by a similar procedure that used for BE122.

Colorless needles (dichloromethane)

m.p. : 186-187℃

^{1}H-NMR ($CDCl_3$) d 1.30 (1 H, t, J = 4.9 Hz), 1.50-3.30 (10 H, br m), 1.95 (2 H, t, J = 7.0 Hz) 3.48 (2 H, dt, J = 4.9, 7.0 Hz), 4.74 (1 H, s), 6.65-6.69 (2 H, m), 6.76 (1H,m), 7.02 (1 H, m)

Anal. Calcd for $C_{10}H_{20}B_{10}O_2 \cdot 0.2H_2O$: C, 42.29; H, 7.24. Found C, 42.12; H, 6.95.

O-Methyl-BE300 was converted to 1-(3-hydroxypropyl)-12-(3-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE323) by a similar procedure that used for BE123.

Colorless needles (dichloromethane)

m.p. : 211-212℃

^{1}H-NMR (DMSO-d_6) d 1.25 (2 H, m), 1.40-3.20 (10 H, br m), 1.73 (2 H, m) 3.23 (2 H, dt, J = 5.1,5.7 Hz), 4.39 (1 H, t, J = 5.1 Hz), 6.57-6.59 (2 H, m), 6.64 (1H,m), 7.01 (1 H, m), 9.54 (1 H, s)

Anal. Calcd for $C_{11}H_{22}B_{10}O_2 \cdot 0.1H_2O$: C, 44.60; H, 7.55. Found C, 44.30; H, 7.28.

1,7-Dicarba-*closo*-dodecaborane was converted to 1-(3-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE400) via O-methyl-BE400 by a similar procedure that used for BE100.

Colorless needles (dichloromethane/n-hexane)

m.p. : 140-141℃

^{1}H-NMR ($CDCl_3$) d 1.40-3.80 (10 H, br m), 3.05 (1 H, br s), 4.70 (1 H, s), 6.75 (1 H, dd, J = 2.6, 8.1 Hz), 6.90 (1 H, t, J = 2.2 Hz), 6.99 (1 H, br d, J = 8.1 Hz), 7.11 (1 H, t, J = 8.1 Hz)

Anal. Calcd for $C_8H_{16}B_{10}O$: C, 40.66; H, 6.82. Found C, 40.48; H, 6.56.

O-Methyl-BE400 was converted to 1-hydroxy-7-(3-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE419) by a similar procedure that used for BE119.

Colorless needles (dichloromethane/n-hexane)

m.p. : 135-136℃

^{1}H-NMR ($CDCl_3$) d 1.40-4.00 (10 H, br m), 4.70 (1 H, br), 6.76 (1 H, ddd, J = 1.0, 2.5, 8.1 Hz), 6.89 (1 H, t, J = 2.5 Hz), 6.99 (1 H, ddd, J = 1.0, 2.5, 8.1 Hz), 7.12 (1 H, t, J = 8.1 Hz)

Anal. Calcd for $C_8H_{16}B_{10}O_2$: C, 38.08; H, 6.39. Found C, 37.79; H, 6.37.

O-Methyl-BE400 was converted to 1-(2-hydroxymethyl)-7-(3-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE420) by a similar procedure that used for BE120.

Colorless needles (dichloromethane/n-hexane)

m.p. : 140-141℃

^{1}H-NMR ($CDCl_3$) d 1.50-3.80 (10 H, br m), 1.91 (1 H, t, J = 7.2 Hz), 3.87 (2 H, d, J = 7.2 Hz), 4.90 (1 H, s), 6.76 (1 H, ddd, J = 0.9, 2.2, 8.0 Hz), 6.91 (1 H, t, J = 2.2 Hz), 6.99 (1 H, ddd, J = 0.9, 2.2, 8.0 Hz), 7.11 (1 H, t, J = 8.0 Hz)

Anal Calcd for $C_9H_{18}B_{10}O_2$: C, 40.59; H, 6.81. Found C, 40.33; H, 6.81.

O-Methyl-BE400 was converted to 1-(2-hydroxyethyl)-7-(3-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE422) by a similar procedure that used for BE122.

Colorless needles (dichloromethane/n-hexane)

m.p. : 126-127℃

^{1}H-NMR ($CDCl_3$) d 1.42 (1 H, t, J = 5.5 Hz), 1.30-3.60 (10 H, br m), 2.28 (2 H, t, J = 6.5 Hz) 3.68 (2 H, dt, J =5.5, 6.5 Hz), 4.84 (1 H, s), 6.75 (1 H, ddd, J = 0.9, 2.1, 7.9 Hz), 6.89 (1 H, t, J = 2.1 Hz), 6.98 (1 H, ddd, J = 0.9, 2.1, 7.9 Hz), 7.11 (1 H, t, J = 7.9 Hz)

Anal. Calcd for $C_{10}H_{20}B_{10}O_2$: C, 42.84; H, 7.19. Found C, 42.65; H, 6.90.

O-Methyl-BE400 was converted to 1-(3-hydroxypropyl)-7-(3-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE423) by a similar procedure that used for BE123.

Colorless needles (dichloromethane/n-hexane)

m.p. : 106-107℃

^{1}H-NMR ($CDCl_3$) d 1.26 (1 H, t, J = 5.1 Hz), 1.50-3.70 (10 H, br m), 1.67 (2 H, m), 2.11 (2 H, m), 3.60 (2 H, dt, J =5.1, 5.6 Hz), 4.87 (1 H, s), 6.75 (1 H, ddd, J = 0.7, 2.1, 8.1 Hz), 6.90 (1 H, t, J = 2.1 Hz), 6.98 (1 H, ddd, J = 0.7, 2.1, 8.1 Hz), 7.11 (1 H, t, J = 8.1 Hz)

Anal. Calcd for $C_{11}H_{22}B_{10}O_2$: C, 44.88; H, 7.53. Found C, 44.58; H, 7.35.

Potassium carbonate (97.8 mg, 0.708 mmol) was added to a DMF solution of 1,12-bis (4-hydroxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE160)(155 mg, 0.472 mmol) and $(CH_3)_2NCH_2CH_2Cl \cdot HCl$ (68.0 mg, 0.472 mmol), and stirred at 65℃ for 22h. The reaction was quenched by the addition of water, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : chloroform/methanol=10/1) to give 1-(4-hydroxyphenyl)-12-(4-dimethylaminoethoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE162)(34%)

Colorless prisms (ethyl acetate/n-hexane)

m.p. : 233-235℃

^{1}H-NMR (DMSO-d_6) δ 1.60-3.40 (10 H, br m), 2.17 (6 H, s), 2.56 (2 H, t, J = 5.8 Hz), 3.98 (2 H, t, J = 5.8 Hz), 6.61 (2 H, d, J = 8.8 Hz), 6.79 (2 H, d, J = 9.0 Hz), 7.00 (2 H, d, J = 8.8 Hz) 7.11 (2 H, d, J = 9.0 Hz), 9.65 (1 H, s)

Anal. Calcd for $C_{18}H_{29}B_{10}NO_2$: C, 54.11; H, 7.32; N, 3.51. Found C, 54.01; H, 7.22; N, 3.36.

1-12-Bis(3-hydroxyphenyl)-1,12-dicarba-*closo*-decaborane was converted to 1-(2-hydroxyphenyl)-12-(3-dimethylaminoethoxyphenyl)-1,12-dicarba-*closo*-dodecaborane (BE172) by a similar procedure that used for BE162.

Colorless needles (dichloromethane/n-hexane)

m.p. : 183-185℃

^{1}H-NMR (DMSO-d_6) δ 1.70-3.50 (10 H, br m), 2.19 (6 H, s), 2.57 (2 H, t, J = 5.8 Hz), 3.99 (2 H, t, J = 5.8 Hz), 6.63-6.64 (2 H, m), 6.67-6.68 (2 H, m), 6.79 (1 H, br d, J = 7.7 Hz) 6.90 (1 H, dd, J = 2.4,8.2 Hz), 7.04 (1 H, m), 7.17 (1 H, t, J = 8.2 Hz), 9.59 (1 H, s)
Anal. Calcd for $C_{18}H_{29}B_{10}NO_2 \cdot 0.2H_2O$: C, 53.63; H, 7.35; N, 3.47. Found C, 53.56; H, 7.30; N, 3.36.

1,7-Bis(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane was converted to 1-(4-hydroxyphenyl)-7-(4-dimethylaminoethoxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE262) by a similar procedure that used for BE162.
Colorless prisms (dichloromethane/n-hexane)
m.p. : 166-167℃
^{1}H-NMR (DMSO-d_6) δ 1.40-3.80 (10 H, br m), 2.18 (6 H, s), 2.59 (2 H, t, J = 5.8 Hz), 4.02 (2 H, t, J = 5.8 Hz), 6.69 (2 H, d, J = 8.8 Hz), 6.88 (2 H, d, J = 8.8 Hz), 7.27 (2 H, d, J = 8.8 Hz) 7.37 (2 H, d, J = 8.8 Hz), 9.74 (1 H, s)
Anal. Calcd for $C_{18}H_{29}B_{10}NO_2$: C, 54.11; H, 7.32; N, 3.51. Found C, 53.84; H, 7.14; N, 3.21.

1,7-Bis(3-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaborane was converted to 1-(3-hydroxyphenyl)-7-(3-dimethylaminoethoxyphenyl)-1,7-dicarba-*closo*-dodecaborane (BE272) by a similar procedure that used for BE162.
Colorless prisms (dichloromethane/n-hexane)
m.p. : 129-131℃
^{1}H-NMR (DMSO-d_6) δ 1.40-3.80 (10 H, br m), 2.20 (6 H, s), 2.59 (2 H, t, J = 5.8 Hz), 4.04 (2 H, t, J = 5.8 Hz), 6.76 (1 H, dd, J = 2.3,8.0 Hz), 6.88-6.94 (3 H, m), 6.98 (1 H, dd, J = 2.6,8.0 Hz), 7.06 (1 H, br d, J = 8.0 Hz), 7.13 (1 H, t, J = 8.0 Hz), 7.26 (1 H, t, J = 8.0 Hz), 9.68 (1 H, s)
Anal. Calcd for $C_{18}H_{29}B_{10}NO_2$: C, 54.11; H, 7.32; N, 3.51. Found C, 53.85; H, 7.17; N, 3.52.

To a mixture of 4-ethynylanisole (700 mg, 5.30 mmol), 4-iodoanisole (1.30 g, 5.55 mmol), $(PPh_3)_2PdCl_2$ (74.4 mg, 0.106 mmol), and CuI (10.1 mg, 0.053 mmol) in THF (7 ml), diisopropyl amine (1.13 g, 11.1 mmol) was added dropwise under ice

cooling under argon atmosphere. After stirring at room temperature for 1h, water was added, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane /ethyl acetate=15/1) to give bis(4-methoxyphenyl)ethyne (95%).

^{1}H-NMR ($CDCl_3$) d 3.82 (6 H, s), 6.86 (4 H, d, J = 8.9 Hz), 7.44 (4 H, d, J = 8.9 Hz).

A mixture of bis(4-methoxyphenyl) ethyne(700 mg, 2.94 mmol) and decaborane (14) (359 mg, 2.94 mmol) in acetonitrile (2 ml)/benzene (20 ml) was heated to reflux for 28h under argon atmosphere. After cooling, methanol (20 ml) was added, and the mixture was stirred at room temperature for 12h. Then, the mixture was concentrated, and the residue was purified by silica gel column chromatography (eluent: n-hexane/ethyl acetate=8/1) to give 1,2-bis(4-methoxyphenyl)-1,2-dicarba-*closo*-dodecaborane (31%).

^{1}H-NMR ($CDCl_3$) d 1.50-3.90 (10 H, br m), 3.72 (6 H, s), 6.63 (4 H, d, J = 9.1 Hz), 7.34 (4 H, d, J = 9.1 Hz)

To a solution of 1,2-bis(4-methoxyphenyl)-1,2-dicarba-*closo*-decaborane (293 mg, 0.882 mmol) in dichloromethane (10 ml), 1M BBr_3 dichloromethane solution (4.12 ml) was added dropwise at −78℃. Then, the mixture was stirred at room temperature for 4h, poured into ice water, and extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : n-hexane/ethyl acetate=3/1) to give 1,2-bis(4-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaborane (100%).

Colorless prisms (n-hexane/ethyl acetate)

m.p. : 179-181℃

^{1}H-NMR (DMSO-d_6) δ 1.40-3.80 (10 H, br m), 6.57 (4 H, d, J = 8.8 Hz), 7.27 (4 H, d, J = 8.8 Hz) 9.91 (2 H, s)

Anal Calcd for $C_{14}H_{20}B_{10}O_2$: C, 51.20; H, 6.14. Found C, 50.96; H, 6.15.

To a solution of 1,2-bis(4-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaborane (150 mg, 0.457 mmol) and $(CH_3)_2NCH_2CH_2Cl \cdot HCl$ (65.8 mg, 0.457 mmol) in DMF,

potassium carbonate (94.7 mg, 0.685 mmol) was added, and stirred at 65℃ for 20h. Water was added, and the mixture was extracted with ethyl acetate. The organic layer was washed with water then saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : chloroform/methanol =30/1→10/1) to give 1-(4-hydroxyphenyl)-2-(4-dimethylamino-ethoxyphenyl)- 1,2-dicarba-*closo*-dodecaborane (BE362)(16%).

Colorless needles (dichloromethane/n-hexane).

m.p. : 177-179℃

^{1}H-NMR (DMSO-d_6) δ 1.50-3.60 (10 H, br m), 2.15 (6 H, s), 2.53 (2 H, t, J = 5.9 Hz), 3.96 (2 H, t, J = 5.9 Hz), 6.57 (2 H, d, J = 8.6 Hz), 6.77 (2 H, d, J = 8.6 Hz), 7.29 (2 H, d, J = 8.6 Hz) 7.38 (2 H, d, J = 8.6 Hz), 9.92 (1 H, s)

Anal. Calcd for $C_{18}H_{29}B_{10}NO_2 \cdot 0.2H_2O$: C, 53.63; H, 7.35; N, 3.47. Found C, 53.45; H, 7.22; N, 3.27.

To a mixed solution of 3-ethynylanisole (347.0 mg, 2.63 mmol), 3-iodoanisole (670.0 mg, 2.86 mmol, 1.1 eq), $(PPh_3)_2PdCl_2$ (37.2 mg, 0.0530 mmol, 0.02 eq), CuI (5.1 mg, 0.0268 mmol, 0.01 eq) in THF (5 ml), diisopropylamine (0.57 g, 5.63 mmol, 2.1 eq) was added at 0℃, and stirred at room temperature for 1h. Water was added to the reaction mixture, and the mixture was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent : ethyl acetate/n-hexane=1/15) to give bis(3-methoxyphenyl)ethyne (594.4mg, 95.0%).

Light yellow prisms (n-hexane)

m.p. : 61-62℃

^{1}H-NMR ($CDCl_3$) d3.83 (6 H, s), 6.89 (2 H, ddd, J = 1.0,2.6,8.3 Hz), 7.06 (2 H, dd, J = 1.3,2.6 Hz,), 7.13 (2 H, dt, J = 1.2,7.7 Hz), 7.25 (2 H, t, J = 8.0 Hz)

Anal. Calcd for $C_{16}H_{14}O_2$: C, 80.65; H, 5.92. Found C, 80.49; H, 6.01

HRMS Cacld for $C_{16}H_{14}O_2$ 238.0994, Found 238.1002

A solution of bis(3-methoxyphenyl)ethyne (501.6 mg, 2.10 mmol), decaborane (14)(258.1 mg, 2.11 mmol) in benzene (15 ml), and acetonitrile (1.5 ml) was refluxed for 46h under argon atmosphere. After cooling to room temperature, the reaction

mixture was diluted with methanol, stirred for 1h and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane)=1/8) to give 1,2-bis (3 -methoxyphenyl)-1,2-dicarba-*closo*-dodecaborane (367.9 mg, 49.0%).
Colorless prisms (dichloromethane/n-hexane)
m.p. :116-118℃
^{1}H-NMR ($CDCl_3$) d1.7-3.6 (10 H, br m), 3.68 (6 H, s), 6.77 (2 H, ddd, J = 1.8,2.3,7.5 Hz), 6.96 (2 H, t, J = 2.0 Hz), 7.03(2 H, dt, J = 1.8,7.9Hz), 7.06 (2 H, t, J = 7.6Hz)
Anal. Calcd for $C_{16}H_{24}B_{10}O_2$: C, 53.91; H, 6.79. Found C, 3.61; H, 6.75.
HRMS Calcd for $C_{16}H_{24}{}^{10}B_2{}^{11}B_8O_2$ 356.2779, Found 356.2782

1,2-Bis(3-methoxyphenyl)-1,2-dicarba-*closo*-dodecaborane (317.7 mg, 0.891 mmol) was dissolved in dichloromethane (3 ml), cooled to −78℃, BBr_3 (1-dichloromethane solution) (2.67 ml, 2.67 mmol, 3 eq) was added to the solution and the mixture was stirred at room temperature for 1h. The mixture was poured ino ice water, and the organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane=1/1) to give 1,2-bis(3-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaborane (BE370)(297.4 mg, 100%).
Colorless needles (dichloromethane/n-hexane)
m.p. : 202-203℃
^{1}H-NMR ($CDCl_3$) d1.7-3.6 (10 H, br m), 4.90 (2 H, br s), 6.71 (2 H, m), 6.93 (2 H, t, J = 1.3Hz), 7.00 (2 H, m), 7.02 (2 H, t, J = 7.6Hz)
Anal. Calcd for $C_{14}H_{20}B_{10}O_2 \cdot 1/6H_2O$: C, 50.74; H, 6.18. Found C, 50.75; H, 6.14.
HRMS Calcd for $C_{14}H_{20}{}^{10}B_2{}^{11}B_8O_2$ 328.2466, Found 328.2436

To a solution of 1,2-bis(3-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaborane (210.9 mg, 0.642 mmol) in DMF (7 ml), $(CH_3)_2NCH_2CH_2Cl \cdot HCl$ (92.5 mg, 0.642 mmol, 1 eq) and potassium carbonate (133.1 mg, 0.963 mmol, 1.5 eq) were added, and stirred at 65℃ for 24h. Water was added to the reaction mixture, and the mixture was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: dichloromethane/methanol=10/1) to give 1-(3-

hydroxyphenyl)-2-(3-dimethylaminoethoxyphenyl)-1,2-dicarba-*closo*-dodecaborane (BE372) (9.0 mg, 4%).

Colorless prisms (dichloromethane/n-hexane)

m.p. : 192-193℃

^{1}H-NMR (DMSO-d_6) δ 1.6-3.5 (10 H, br m), 2.16 (6 H, s), 2.52 (2 H, t, J = 5.7Hz), 3.93 (2 H, t, J = 5.9Hz), 6.71 (1 H, d, J = 7.9Hz), 6.93 (4 H, m), 7.03 (1 H, t, J = 8.0 Hz), 7.08 (1 H, d, J = 8.1Hz), 7.16 (1 H, t, J = 8.1Hz), 9.69 (1 H, br s)

HRMS Calcd for $C_{18}H_{29}{}^{10}B_2{}^{11}B_8NO_2$ 399.3201, Found 399.3209

Example 16

To a solution of 1-(4-methoxyphenyl)-1,7-dicarba-*closo*-dodecaborane (O-methyl-BE200) (550 mg, 2.20 mmol) in benzene (10 ml)-diethyl ether (5 ml), n-BuLi (1.57 M in hexane)(2.10 ml, 3.30 mmol, 1.5 eq) was added at 0℃ under argon atmosphere, then the mixture was stirred at room temperature for 30 min. After the treatment, 2-(11-bromo-n-undecanoyloxy) tetrahydro-2H-pyran (736.7 mg, 2.20 mmol, 1 eq) was added at 0℃, then stirred at room temperature for 20h. Water was added to the mixture, and the mixture was extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane=1/30) to give 1-(4-methoxyphenyl)-7-(11-tetrahydroxypyranyloxy-n-undecane-1-yl)-1,7-dicarba-*closo*-dodecaborane.(360.3mg, 32.5%).

^{1}H-NMR ($CDCl_3$) d1.15-1.42 (16 H, m), 1.48-1.63 (6 H, m), 1.6-3.1 (10 H, br m), 1.71 (1 H, m), 1.82 (1 H, m), 1.96 (2 H, m), 3.38 (1 H, dt, J = 6.6,9.5 Hz), 3.50 (1 H, m), 3.73 (1 H, dt, J = 6.6,9.5 Hz), 3.77 (3 H, s), 3.87 (1 H, m), 4.57 (1 H, m), 6.75 (2 H, d, J = 9.1 Hz), 7.32 (2 H, d, J = 9.1 Hz)

1-(4-Methoxyphenyl)-7-(11-tetrahydropyranyloxy-n-undecane-1-yl)-1,7-dicarba-*closo*-dodecaborane (710 mg, 1.41 mmol) was dissolved in methanol (6 ml), p-toluene sulfonic acid hydrate (26.8 mg, 0.141 mmol, 0.1 eq) was added, and stirred at room temperature for 12h. Saturated sodium hydrogencarbonate solution was added the mixture, and the mixture was extracted with dichloromethane. The organic layer was washed with saturated brine, dried over magnesium sulfate and concentrated.

The residue was purified by silica gel column chromatography (eluent : dichloromethane/n-hexane=2/1) to give 1-(4-methoxyphenyl)-7-(11-hydroxy-n-undecane-1-yl)-1,7-dicarba-*closo*-dodecaborane (512.5 mg, 86.6%)

^{1}H-NMR ($CDCl_3$) d 1.15-1.42 (16 H, m), 1.20 (1 H, t, J = 5.4 Hz), 1.50-1.61 (2 H, m), 1.6-3.1 (10 H, br m), 1.96 (2 H, m), 3.64 (2 H, td, J = 5.5,6.5 Hz), 3.77 (3 H, s), 6.75 (2 H, d, J = 9.0 Hz), 7.32 (2 H, d, J = 9.0 Hz)

HRMS Calcd for $C_{20}H_{40}{}^{10}B_2{}^{11}B_8O_2$ 420.4031, Found 420.4043

1-(4-Methoxyphenyl)-7-(11-hydroxy-n-undecane-1-yl)-1,7-dicarba-*closo*-dodecaborane (512.5 mg, 1.22 mmol) was dissolved in acetone (3 ml), CrO_3 (609.9 mg, 6.10 mmol, 5 eq)/20%sulfuric acid solution (3 ml) was added at 0℃, then stirred at room temperature for 3h. The mixture was poured into ice water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane-1/2→chloroform/methanol =30/1) to give 11-{1-(4 -methoxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl}-n-undecanoic acid 1-(4-methoxyphenyl)-7-(11-hydroxy-n-undecane-1-yl)-1,7-dicarba-*closo*-dodecaboranyl ester (295.5 mg, 57.9%) and 11-[1-(4-methoxy phenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl]-n-undecanoic acid (54.0 mg, 10.2%). The ester was converted to the carboxylic acid by hydrolysis with sulfuric acid in dioxane (yield 24%)

^{1}H-NMR ($CDCl_3$) d 1.15-1.42 (14 H, m), 1.6-3.1 (10 H, br m), 1.63 (2 H, m), 1.96 (2 H, m), 2.35 (2 H, t, J = 8.6 Hz), 3.77 (3 H, s), 6.75 (2 H, d, J = 9.0 Hz), 7.32 (2 H, d, J = 9.0 Hz)

11-[1-(4-Methoxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl]-n-undecanoic acid (100.0 mg, 0.230 mmol) was dissolved in dichloromethane (1 ml), cooled to −78℃, BBr_3 (1.0 M dichloromethane solution) (0.6 ml, 0.6 mmol, 2.6 eq) was added, and stirred at room temperature for 2h. The mixture was poured in ice water, and extracted with ethyl acetate. The organic layer was washed with saturated brine, dried over magnesium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane=1/1) to give 11-[1-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl}-n-undecanoic acid (69.0 mg, 71.3%).

^{1}H-NMR ($CDCl_3$) d1.15-1.42 (14 H, m), 1.6-3.1 (10 H, br m), 1.63 (2 H, quint, J = 7.5 Hz), 1.96 (2 H, m), 2.35 (2 H, t, J = 7.5 Hz), 6.69 (2 H, d, J = 9.0 Hz), 7.28 (2 H, d, J = 9.0 Hz)

HRMS Calcd for $C_{19}H_{36}{}^{10}B_2{}^{11}B_8O_3$ 420.3668, Found 420.3673

To a solution of 11-[1-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl]-n-undeca noic acid (56.5 mg, 0.134 mmol) and n-butylamine (20.0 mg, 0.237 mmol, 2 eq) in dichloromethane (2 ml), a solution of dicyclohexylcarbodiimide (28.2 mg, 0.137 mmol, 1 eq) in dichloromethane (2 ml) was added at 0℃, then stirred at room temperature for 18h. Insoluble substance was separated by filtration, and the filtrate was concentrated. The residue was purified by silica gel column chromatography (eluent: chloroform/methanol=30/1) to give N-n-butyl-11-[1-(4-hydroxy phenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl]-n-undecanamide (BE520) (20.4 mg, 31.9%).

^{1}H-NMR ($CDCl_3$) d0.92 (3 H, t, J = 7.3 Hz), 1.05-1.42 (18 H, m), 1.48 (2 H, quint, J = 7.6 Hz), 1.6-3.1 (10 H, br m), 1.95 (2 H, m), 2.16 (2 H, t, J = 7.6 Hz), 3.25 (2 H, dt, J = 5.9,7.0 Hz), 5.44 (1 H, br s), 6.30 (1 H, br), 6.71 (2 H, d, J = 8.8 Hz), 7.26 (2 H, d, J = 8.8 Hz)

HRMS Calcd for $C_{23}H_{45}{}^{10}B_2{}^{11}B_8NO_2$ 475.4453, Found 475.4460

To a solution of 11-[1-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl]-n-undecanoic acid (50.6 mg, 0.120 mmol), N-methyl-n-butylamine (20.9 mg, 0.240 mmol, 2 eq), and N-hydroxysuccinimide (13.9 mg, 0.121 mmol, 1 eq) in DMF (1.5 ml), and a solution of dicyclohexyl carbodiimide (25.0 mg, 0.121 mmol, 1 eq) in DMF (1.5 ml) was added at 0℃, then stirred at room temperature for 48 h. DMF was removed under reduced pressure, and ethyl acetate was added to the residue. After the insoluble substance was removed by filtration, the filtrate was concentrated. The residue was purified by silica gel column chromatography (eluent: chloroform/methanol=30/1) to give N-n-butyl-N-methyl-11-[1-(4-hydroxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl]-n-undecanamide (BE521) (17.1 mg, 29.0%).

^{1}H-NMR ($CDCl_3$) d 0.91, 0.95 (3 H, t×2, J = 7.6 Hz), 1.05-1.42 (18 H, m), 1.45-1.60 (2 H, m), 1.6-3.1 (10 H, br m), 1.95 (2 H, m), 2.29, 2.31(2 H, t×2, J = 7.4 Hz), 2.92, 2.98(3 H, s×2), 3.26, 3.36 (2 H, t×2, J = 7.5 Hz), 6.72 (2 H, d, J = 8.8 Hz), 7.25 (2 H, d, J = 8.8 Hz)

(1:1 mixture of cis, trans conformations of amide)

HRMS Calcd for $C_{24}H_{47}{}^{10}B_2{}^{11}B_8NO_2$ 489.4610, Found 489.4613

A solution of 4-ethynylanisole (2.70 g, 20.4 mmol) and decaborane (14)(2.50 g, 20.5 mmol) in benzene (100 ml) and acetonitrile (10 ml) was refluxed for 17h under argon atmosphere. After cooling to room temperature, the mixture was diluted with methanol, stirred for 1h and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane=1/15) to give 1-(4-methoxyphenyl)-1,2-dicarba-*closo*- dodecaborane (1.26 g, 24.6%).

Colorless prisms (hexane)

m.p. : 109-111℃

^{1}H-NMR ($CDCl_3$) d1.6-3.4 (10 H, br m), 3.80 (3 H, s), 3.87 (1 H, br s), 6.82 (2 H, d, J = 9.1Hz), 7.42 (2 H, d, J = 9.2Hz)

HRMS Calcd for $C_9H_{18}{}^{10}B_2{}^{11}B_8O$ 250.2361, Found 250.2358

To a suspension of sodium hydride (60%)(302 mg, 7.55 mmol, 1.5 eq, washed with n-hexane) in DMF (6 ml), 1-(4-methoxyphenyl)-1,2-dicarba-*closo*-dodecaborane (1.26 g, 5.03 mmol) in DMF (30 ml) was added. After stirring at room temperature for 5 min, DMF solution (6 ml) of 2-(11-bromo-n-undecanoyloxy) tetrahydro-2H-pyran (1.69 g, 5.03 mmol) was added, and stirred at room temperature for 2h. The reaction mixture was poured into 2N hydrochloric acid under ice cooling, and extracted with ether. The organic layer was washed with saturated brine, dried over sodium sulfate and concentrated. The residue was purified by silica gel column chromatography (eluent: ethyl acetate/n-hexane=1/30) to give 1-(4-methoxyphenyl)-2-(11-tetrahydropyranyloxy-n-undecane-1-yl)-1,2- dicarba-*closo*-dodecaborane (1.27 g, 50.0%).

^{1}H-NMR ($CDCl_3$) d1.00-1.40 (16 H, m), 1.48-1.62 (6 H, m), 1.6-3.1 (10 H, br m), 1.68-1.77 (3 H, m), 1.83 (1 H, m), 3.37 (1 H, dt, J = 7.0,9.6 Hz), 3.50 (1 H, m), 3.72 (1 H, dt, J = 7.0,9.6 Hz), 3.83 (3 H, s), 3.87 (1 H, m), 4.57 (1 H, m), 6.86 (2 H, d, J = 9.0 Hz), 7.52 (2 H, d, J = 9.0 Hz)

The protecting tetrahydropyranyl group of 1-(4-methoxyphenyl)-2-(11-tetrahydropyranyloxy-n-undecane-1-yl)-1,2-dicarba-*closo*-dodecaborane was

deprotected by a similar procedure that used for 1-(4-methoxyphenyl)-7-(11-hydroxy-n-undecane-1-yl)-1,7-dicarba-*closo*-dodecaborane to give 1-(4-methoxyphenyl)-2-(11-hydroxy-n-undecane-1-yl)-1,2-dicarba-*closo*-dodeca borane (92.1 %).
^{1}H-NMR ($CDCl_3$) d1.10-1.42 (16 H, m), 1.20 (1 H, t, J = 5.4 Hz), 1.50-1.60 (2 H, m), 1.6-3.1 (10 H, br m), 1.74 (2 H, m), 3.63 (2 H, td, J = 5.3, 6.6 Hz), 3.83 (3 H, s), 6.87 (2 H, d, J = 9.0 Hz), 7.52 (2 H, d, J = 9.0 Hz)
HRMS Calcd for $C_{20}H_{40}{}^{10}B_2{}^{11}B_8O_2$ 420.4031, Found 420.4062

1-(4-Methoxyphenyl)-2-(11-hydroxy-n-undecane-1-yl)-1,2-dicarba-*closo*-dodecaborane was converted to 11-{1-(4-methoxyphenyl)-1,2-dicarba-*closo*-dodeca-boran-2-yl}-n-undecanoic acid (13.5 mg, 70.0%) by a similar procedure that used for 11-{1-(4-methoxyphenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl}-n-undecanoic acid.
^{1}H-NMR ($CDCl_3$) d1.00-1.40 (14 H, m), 1.6-3.1 (10 H, br m), 1.61 (2 H, quint, J = 8.6 Hz), 1.74 (2 H, m), 2.34 (2 H, t, J = 8.6 Hz), 3.83 (3 H, s), 6.86 (2 H, d, J = 9.0 Hz), 7.52 (2 H, d, J = 9.0 Hz)

11-{1-(4-Methoxyphenyl)-1,2-dicarba-*closo*-dodecaboran-2-yl}-n-undecanoic acid was converted to 11-{1-(4-hydroxyphenyl)-1,2-dicarba-*closo*- dodecaboran-2-yl}-n-undeca noic acid (74.0 %) by a similar procedure that used for 11-{1-(4-methoxy-phenyl)-1,7-dicarba-*closo*-dodecaboran-7-yl}-n-undecanoic acid.
^{1}H-NMR ($CDCl_3$) d1.00-1.40 (14 H, m), 1.5-3.2 (10 H, br m), 1.62 (2 H, quint, J = 7.5 Hz), 1.76 (2 H, m), 2.37 (2 H, t, J = 7.3 Hz), 6.81 (2 H, d, J = 9.0 Hz), 7.48 (2 H, d, J = 8.8 Hz)
HRMS Calcd for $C_{19}H_{36}{}^{10}B_2{}^{11}B_8O_3$ 420.3668, Found 420.3655

To a solution of 11-{1-(4-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaboran -2-yl}-n-undecanoic acid (29.8 mg, 0.0709 mmol) and n-butylamine (10.4 mg, 0.142 mmol, 2 eq) in acetonitrile (1 ml), a solution of dicyclohexylcarbodiimide (16.1 mg, 0.0780 mmol, 1.1 eq) in acetonitrile (1 ml) was added at 0℃, and stirred at room temperature for 6h. Acetonitrile was removed under reduced pressure. Ethyl acetate was added to the residue to remove the insoluble substance by filtration, and the filtrate was concentrated. The residue was purified by silica gel column chromatography (eluent : chloroform/methanol=30/1), and further purified by silica gel column chromatography

(eluent : ethyl acetate/n-hexane=1/2) to give N-n-butyl-11-{1-(4-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaboran-2-yl} -n-undecanamide (BE530) (12.8 mg, 38.0%)
^{1}H-NMR ($CDCl_3$) d 0.85-1.40 (18 H, m), 0.95 (3 H, t, J = 7.3 Hz), 1.50-1.60 (2 H, m), 1.5-3.2 (10 H, br m), 1.80 (2 H, m), 2.22 (2 H, t, J = 7.3 Hz), 3.31 (2 H, dt, J = 5.8,7.1 Hz), 5.60 (1 H, br s), 6.86 (2 H, d, J = 8.8Hz), 7.44 (2 H, d, J = 9.0 Hz), 9.50 (1 H, br s)
HRMS Calcd for $C_{23}H_{45}{}^{10}B_2{}^{11}B_8NO_2$ 475.4453, Found 475.4450

To a solution of 11-{1-(4-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaboran-2-yl}-n-undecanoic acid (79.4 mg, 0.189 mmol) and N-methyl-n-butylamine (32.9 mg, 0.378 mmol, 2 eq) in acetonitrile (2 ml), and a solution of dicyclohexylcarbodiimide (43.0 mg, 0.208 mmol, 1.1 eq) in acetonitrile (2 ml) was added at 0℃, and stirred at room temperature for 20h. Acetonitrile was removed under reduced pressure. Ethyl acetate was added to the residue to remove the insoluble substance by filtration, and the filtrate was concentrated. The residue was purified by silica gel column chromatography (eluent : chloroform/methanol=30/1), and further purified by preparative thin-layer chromatography (eluent : dichloromethane /n-hexane=30/1) to give N-n-butyl-N-methyl-11-{1-(4-hydroxyphenyl)-1,2-dicarba-*closo*-dodecaboran-2-yl}-n-undecanamide (BE531)(24.8 mg, 26.8%).
^{1}H-NMR ($CDCl_3$) d0.85-1.40 (18 H, m), 0.94, 0.97 (3 H, t×2, J = 7.3Hz), 1.50-1.65 (2 H, m), 1.5-3.2 (10 H, br m), 1.79 (2 H, m), 2.35, 2.36 (3 H, t×2, J = 7.3Hz), 2.98, 3.02 (3 H, s×2), 3.30, 3.42 (3 H, t×2, J = 7.5Hz), 6.87, 6.88 (2 H, d×2, J = 8.9Hz), 7.43 (2 H, d, J = 8.1 Hz), 9.79, 9.82 (1 H, br s×2) (1 to1 cis, trans conformational mixture of amide)
HRMS Calcd for $C_{24}H_{47}{}^{10}B_2{}^{11}B_8NO_2$ 489.4610, Found 489.4607

Test Example

Anti-leukemia activity test and estrogen activity test were performed on nuclear receptor regulators having a dicarba-*closo*-dodecaborane structure of the present invention obtained in the examples.

(1) Anti-leukemia Activity

Inhibitory activity against proliferation of human promyelocytic leukemia cell strain HL-60 was evaluated an index of anti-leukemia activity. Subcultured HL-60 cells were seeded with the initial cell number of 8×10^4 cells/ml in the RPMI 1640

medium containing bovine fetal serum and an antibiotics. Each test compound was added at various concentrations and the mixture was cultured at 37℃. Four days later, cell number was counted. Anti-leukemia activity of each test compound was shown in the tables as percentage values of differentiated cells, which cells were not differentiated in the absence of the test drug, in the presence of 1 mM of the test compound based on morphological change observation and NBT reducing ability of the cells as indexes. Table 1 shows the results obtained by experiments wherein only the test compounds were added. BR401, BR403, and BR453 were found to have strong differentiation inducing activities and the activities were maintained at 0.01 μ M concentration of the test compounds.

Table 2 shows the results of experiments with coexistence of the compound AM80 as a differentiation inducing agent (4-[(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthalenyl)carbamoyl]benzoic acid). As a result, BR201 was found to have a strong anti-differentiation activity. Table 3 shows the results of experiments with coexistence of the compound HX630 (4-[2,3-(2,5-dimethyl-2,5-hexano)dibenzo-[b,f]-[1,4]thiazepin-11-yl]benzoic acid) which is inactive per se but enhances the action of differentiation inducing substances. As a result, BR110, BR251, and BR350 were found to have differentiation inducing activities.

Table 1

Test Compound 1 μ M	No coexisting compound (control:<10)
BR10	8
BR20	12
BR30	7
BR110	12
BR201	11
BR251	8
BR300	6
BR350	11
BR401	70
BR403	82
BR431	10
BR453	80
BR401*	26
BR403*	84
BR453*	80

*Test Compound 0.01 μ M

Table 2

Test Compound	Coexisting compound Am80 3.3×10^{-10}M (control: 55)
BR10	65
BR20	70
BR30	66
BR110	60
BR201	5
BR251	55
BR300	37
BR350	60
BR401	60
BR431	55

Table 3

Test Compound	Coexisting Compound HX630 1×10^{-7}M (control: <10)
BR10	7
BR20	10
BR30	9
BR110	48
BR201	12
BR251	77
BR300	8
BR350	48
BR401	75
BR431	12

Table 4 shows the concentrations of the test compounds as IC_{50} values which inhibited 50% of differentiation inducing activity when the compound Am80 as a differentiation inducing agent coexisted at 1×10^{-9} M. BR630 and BR635 were found to have remarkable anti-differentiation activities.

Table 4

Test Compound	IC_{50} (mM) Coexisting compound: Am80 1×10^{-9}M
BR630	0.025
BR635	0.028
BR638	0.61
BR10	inactive
BR20	inactive
BR30	inactive

(2) Estrogenic Activity

As estrogenic activity, estrogen receptor-dependent transcriptional activation abilities of the test compounds were determined by the reporter gene assay using luciferase gene. COS-1 cells were cultured using a DMEM medium containing an antibiotics and 5% bovine fetal serum in the wells of 24 well plates (cell density : 5 to 6

$\times 10^4$/well) at 37℃ for one night under 5% carbon dioxide. On the next day, the medium was changed to DMEM medium not containing Phenol Red. Using gene introducing reagent Tfx-20 (Promega), reporter plasmid EREx3-pGL-TK, in which rat estrogen receptor expression plasmid pCI-rER α and an estrogen responsive sequence were placed upstream of the luciferase gene, and β-galactosidase expression plasmid pCMV β used as an internal standard were introduced into cells. The cells were cultured for 2h, and the medium was changed to DMEM not containing Phenol Red but containing active charcoal-treated serum.

The culture was added with each test compound dissolved in ethanol at various concentrations (final ethanol concentration at 0.5%) and then cultivation was continued at 37℃ for one night under 5% carbon dioxide. On the next day, the cells were lysed and enzymatic activity of luciferase expressed was measured by using a chemiluminometer. The values were standardized based on galactocidase enzymatic activity, and then compared with the values obtained by experiments using no test compound and used as values of activity at various concentrations. Table 4 shows estrogenic activities. The estrogenic activities in the table are shown as concentrations for 50% activity (EC_{50} values) which give 50% activities relative to luciferase activity regarded as 100 that is expressed by treatment with the control compound β-estradiol at 10 nM. Each compound tested in this experiment has a high estrogenic activity. In particular, BE100, BE120, BE121, and BE140 have much higher activity than that of β-estradiol used as the control.

Table 5

Test Compound	EC_{50} Value (nM)
BE100	0.7
BE110	2.0
BE120	0.05
BE121	1.0
BE130	10
BE140	0.5
BE160	1.0
BE200	2.0
BE260	1.0

Estrogenic activities, i.e., estrogen receptor-dependent transcriptional abilities of test compounds, were determined by the reporter gene assay using the luciferase gene in the same manner as those described above. In this experiment (Table 6), estrogenic activities at 0.1 nM, 1 nM, and 10 nM of the test compounds are shown as relative values in view of the luciferase activity regarded as 100 which is expressed at the same amounts of β-estradiol as a control, and intensities of activities were compared. Each compound tested in this experiment has high estrogenic activity. In particular, BE119, BE120, and BE320 have much higher activities than that of β-estradiol as the control.

Table 6

Test Compound	Relative Activity(%) at the Same Amount of β-estradiol		
	0.1 nM	1 nM	10 nM
BE100	51	63	82
BE119	133	132	120
BE120	212	163	126
BE122	83	98	104
BE123	29	56	79
BE200		45	72
BE219		40	71
BE220		57	116
BE222		38	85
BE223		20	51
BE300		20	59
BE319		53	72
BE320	116	127	127
BE322		43	85
BE323		12	31
BE400		11	38
BE419		14	38
BE420		18	59
BE422		11	24
BE423		<10	15

(3) Antiestrogenic Activity

As antiestrogenic activities, estrogen receptor-dependent transcriptional activation abilities of the test compounds were measured by the reporter gene assay using luciferase gene in the same manner as the estrogen activity measurement. In Table 7, antiestrogenic activities of test compounds are indicated as IC_{50} values as 50% inhibitory concentrations relative to the luciferase activity regarded as 100 which is expressed by β-estradiol at 1 nM coexisting in the experimental system. Each compound tested in this experiment has antiestrogenic activity. In particular, BE362

has strong activity comparable to that of antiestrogenic drug tamoxifen used as a control.

Table 7

Test Compound	IC_{50}Value (nM) Coexisting compound: β -estradiol 1×10^{-9}M
BR162	10*
BR172	600
BR262	200
BR272	500
BR362	30
BR372	200

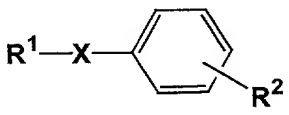
*BE162 was found to achieve incomplete inhibition even at 1 mM (a partial inhibitor)

Industrial Applicability

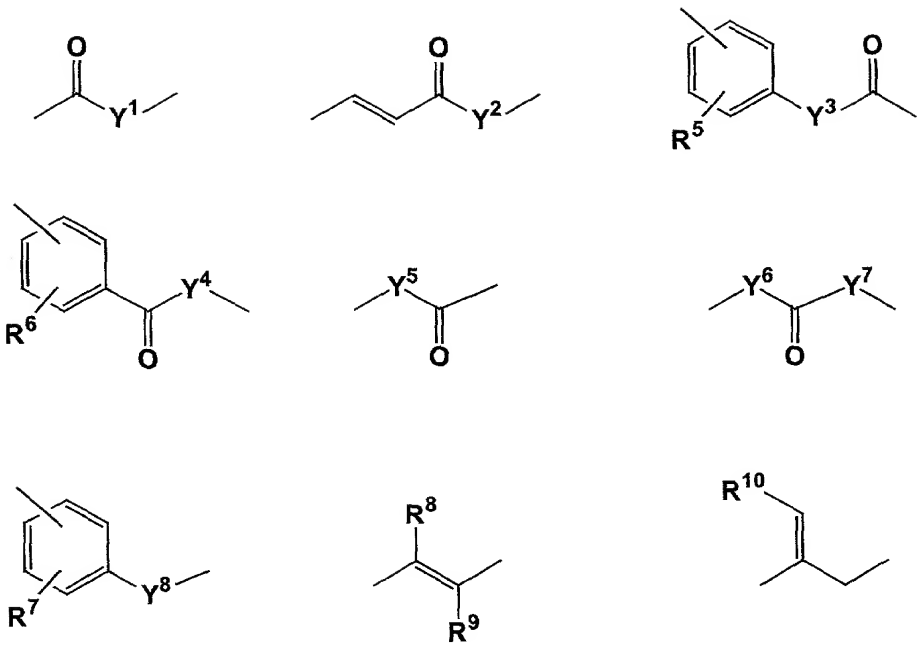
The compounds represented by the aforementioned formula (I) or physiologically acceptable salts thereof have physiological activities such as retinoid activities, and therefore, medicaments of the present invention comprising said substance as an active ingredients are useful for the treatment of leukemia and the like.

What is claimed is:

1. A medicament comprising as an active ingredient a compound or a physiologically acceptable salt thereof represented by the following general formula (I) :



wherein R^1 represents a dicarba-*closo*-dodecaboran-yl group which may have one or more substituents selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a mono- or di-lower alkylcarbamoyl-substituted alkyl group, a lower alkanoyl group, an aryl group which may be substituted, and a lower aralkyl group which may be substituted; R^2 represents carboxyl group, a lower alkoxy carbonyl group, or hydroxyl group ; X represents a single bond or a linking group selected from the group consisting of the groups represented by the following formulas:



wherein, Y^1, Y^2, Y^3, Y^4, Y^5, Y^6, and Y^7 independently represent oxygen atom or -N(R^3)- wherein R^3 represents hydrogen atom or a lower alkyl group; Y^8 represents oxygen atom, -N(R^4)- wherein R^4 represents hydrogen atom or a lower alkyl group, -CO-, -CH_2-, or -C(=CH_2)-; R^5, R^6, and R^7 independently represents hydrogen atom or one or more substituents on the phenyl group; R^8 represents a lower alkyl group or an aryl group which may be substituted, R^9 represents a lower alkyl group, and R^{10} represents an aryl group which may be substituted.

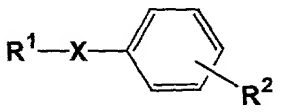
2. The medicament according to claim 1 comprising as an active ingredient the compound or a physiologically acceptable salt thereof represented by the formula (I) wherein R^1 is a dicarba-*closo*-dodecaboran-yl group which may have a lower alkyl group, R^2 is carboxyl group or a lower alkoxycarbonyl group, and X is the above-defined linking group.

3. The medicament according to claim 1 comprising as an active ingredient the compound or a physiologically acceptable salt thereof represented by the formula (I) wherein R^1 is a dicarba-*closo*-dodecaboran-yl group which may have a substituent selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a lower alkanoyl group, a phenyl group which may be substituted,

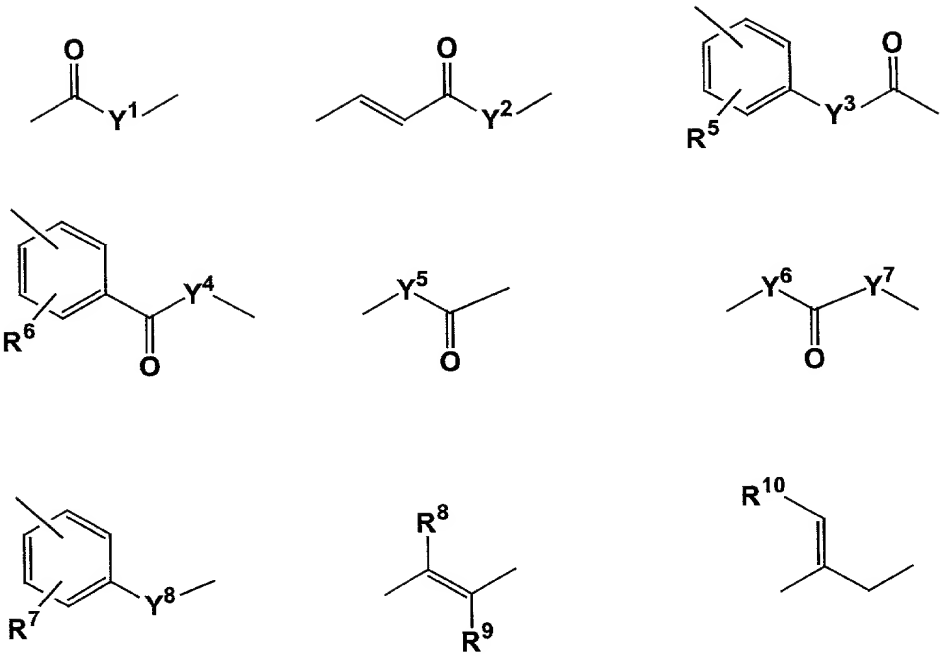
hydroxyphenyl group, and a lower alkoxyphenyl group, R^2 is hydroxyl group, and X is a single bond.

4. A medicament comprising a compound having a dicarba-*closo*-dodecaboran-yl group as a hydrophobic pharmacophore.

5. A compound or a salt thereof represented by the following general formula (I) :



wherein R^1 represents a dicarba-*closo*-dodecaboran-yl group which may have one or more substituents selected from the group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group, a lower hydroxyalkyl group, a mono or di-lower alkylcarbamoyl-substituted alkyl group, a lower alkanoyl group, an aryl group which may be substituted, and a lower aralkyl group which may be substituted; R^2 represents carboxyl group, a lower alkoxy carbonyl group, or hydroxyl group; X represents a single bond or a linking group selected from the group consisting of the groups represented by the following formulas ;



wherein, Y^1, Y^2, Y^3, Y^4, Y^5, Y^6, and Y^7 independently represents oxygen atom or -N(R^3)- wherein R^3 represents hydrogen atom or a lower alkyl group; Y^8 represents oxygen atom, -N(R^4)- wherein R^4 represents hydrogen atom or a lower alkyl group, -CO-, -CH_2-, or -C(=CH_2)-; R^5, R^6, and R^7 independently represents hydrogen atom or one or more substituents on the phenyl group, R^8 represents a lower alkyl group or an aryl group which may be substituted; R^9 represents a lower alkyl group; and R^{10} represents an aryl group which may be substituted,

provided that when X is a single bond,

the compound wherein R^1 is unsubstituted dicarba-*closo*-dodecaboran-yl group and R^2 is hydroxyl group, and

the compound wherein R^1 is dicarba-*closo*-dodecaboran-yl group substituted with p-hydroxyphenyl group and R^2 is hydroxyl group

are excluded.

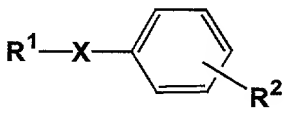
6. The compound or a salt thereof according to claim 5, wherein R^1 is a dicarba-*closo*-dodecaboran-yl group which may have a lower alkyl, R^2 is carboxyl group or a lower alkoxycarbonyl group, and X is the above-defined linking group.

7. The compound or a salt thereof according to claim 5, wherein R^1 is a dicarba-*closo*-dodecaboran-yl group which may have a substituent selected from the

group consisting of a lower alkyl group, a lower alkenyl group, carboxyl group, a lower alkoxycarbonyl group, amino group, hydroxyl group a lower hydroxyalkyl group, a lower alkanoyl group, a phenyl group which may be substituted, hydroxyphenyl group, and a lower alkoxyphenyl group, R^2 is hydroxyl group, and X is a single bond.

ABSTRACT

A medicament comprising as an active ingredient a compound or a physiologically acceptable salt thereof represented by general formula (I):



wherein R^1 represents a dicarba-*closo*-dodecaboran-yl which may be substituted with a lower alkyl group, a lower alkenyl group, carboxyl group or the like; R^2 represents carboxyl group, a lower alkoxycarbonyl group, or hydroxyl group; and X represents a single bond or a linking group such as $-CO-Y^1-$ wherein Y^1 represents oxygen or $-N(R^3)-$ wherein R^3 represents hydrogen or a lower alkyl.

FA1531M/JS

Docket #: p21265.dc1.doc

Declaration and Power of Attorney for Utility or Design Patent Application
特許出願宣言書

Japanese Language Declaration

私は、下欄に氏名を記載した発明者として、以下のとおり宣言する：

私の住所、郵便の宛先および国籍は、下欄に氏名に続いて記載したとおりであり、

名称の発明に関し、請求の範囲に記載した特許を求める主題の本来の、最初にして唯一の発明者である（一人の氏名のみが下欄に記載されている場合）か、もしくは本来の、最初にして共同の発明者である（複数の氏名が下欄に記載されている場合）と信じ、

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DICARBA-closo-DODECABORANE DERIVATIVES

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☐ ____年____月____日に提出され、米国出願番号

_____とし、（該当する場合）

____年____月____日に訂正されました。又は、

特許協定条約国際出願番号_____とし、

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the specification of which is attached hereto unless the following box is checked:

☒ was filed on **21/Jan/00** as United States Application Number **09/868,934** and was amended on **July 18, 2001** (if applicable) or,

PCT International Application Number **PCT/JP/00285** and was amended on _____ (if applicable).

私は、前記のとおり補正した請求の範囲を含む前記明細書の内容を検討し、理解したことを陳述する。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

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I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

私は、合衆国法典第 35 部第 119 条（a-d）項又は第 365 条(b)項に基づく、下記の外国特許出願又は発明者証出願、或いは第 365 条(a)項に基づく、少なくても米国以外の 1 カ国を指名した PCT 国際出願の外国優先権を主張し、更に優先権の主張に係わる基礎出願の出願日前の出願日を有する外国特許出願、又は発明者証出願或るいは PCT 国際出願を以下に“なし”の箱に印をつけることにより明記する：

I hereby claim foreign priority under Title 35, United States Code §119(a-d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States, listed below. I have also identified below, by checking the "No" box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

Prior foreign applications 先の外国出願			Priority claimed 優先権の主張
11/14261 (Number) （番号）	**Japan** (Country) （国名）	**22/Jan/99** (Day/Month/Year Filed) （出願の年月日）	☒ Yes あり ☐ No なし
11/280257 (Number) （番号）	**Japan** (Country) （国名）	**30/Sep/99** (Day/Month/Year Filed) （出願の年月日）	☒ Yes あり ☐ No なし

☐ その他の外国特許出願番号は別紙の追補優先権欄にて記載する。

☐ Additional foreign application numbers are listed a supplemental priority sheet attached hereto.

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Japanese Language Utility or Design Patent Application Declaration

私は、合衆国法典第 35 部第 119 条(e)項に基づく、下記の合衆国仮特許出願の利益を主張する。

I hereby claim the benefit under Title 35, United States Code §119 (e) of any United States provisional application(s) listed below.

(Application No.) （出願番号）	(Day/Month/Year Filed) （出願の年月日）
(Application No.) （出願番号）	(Day/Month/Year Filed) （出願の年月日）
(Application No.) （出願番号）	(Day/Month/Year Filed) （出願の年月日）

☐ その他の合衆国仮特許出願番号は別紙の追補優先権欄にて記載する。

☐ Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.

私は、合衆国法典第 35 部第 120 条に基づく下記の合衆国特許出願、又は第 365 条(c)項に基づく合衆国を指名した PCT 国際出願の利益を主張し、本願の請求の範囲各項に記載の主題が合衆国法典第 35 部第 112 条第 1 項規定の態様で、先の合衆国特許出願又は PCT 国際出願に開示されていない限度において、先の出願の出願日と本願の国内出願日又は PCT 国際出願日の間に有効となった連邦規則法典第 37 部第 1 章第 56 条に記載の特許要件に所要の情報を開示すべき義務を有することを認める。

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s), or §365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

(Application No.) （出願番号）	(Day/Month/Year Filed) （出願の年月日）	(Status) （特許済み、係属中　放棄済み）	(現況) (patented, pending, abandoned)
(Application No.) （出願番号）	(Day/Month/Year Filed) （出願の年月日）	(Status) （特許済み、係属中　放棄済み）	(現況) (patented, pending, abandoned)

☐ その他の合衆国又は国際特許出願番号は別紙の追補優先権欄にて記載する。

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私は、ここに自己のに知識に基づいて行った陳述が全て真実であり、自己の有する情報および信ずるところに従って行った陳述が真実であると信じ、さらに故意に虚偽の陳述等を行った場合、合衆国法典第 18 部第 1001 条により、罰金もしくは禁　に処せられるか、またはこれらの刑が併科され、またかかる故意による虚偽による陳述が本願ないし本願に対して付与される特許の有効性を損なうことがあることを認識して、以上の陳述を行ったことを宣言する。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Docket #: p21265.dc1.doc

Japanese Language Utility or Design Patent Application Declaration

委任状： 私は、下記発明者として、下記に明記された顧客番号を伴う以下の弁護士又は、代理人をここに選任し、本順の手続きを遂行すること並びにこれに関する一切の行為を特許商標庁に対して行うことを委任する。そして全ての通信はこの顧客番号宛に発送される。

顧客番号 7055

現在委任された弁護士は下記の通りである。

Neil F. Greenblum	Reg. No. 28,394
Bruce H. Bernstein	Reg. No. 29,027
James L. Rowland	Reg. No. 32,674
Arnold Turk	Reg. No. 33,094

POWER OF ATTORNEY: As a named inventor, I hereby appoint the attorney(s) and/or agent(s) associated with the Customer Number provided below to prosecute this application and transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to that Customer Number:

CUSTOMER NUMBER 7055

The appointed attorneys presently include:

Stephen M. Roylance	Reg. No. 31,296
William E. Lyddane	Reg. No. 41,568
William Pieprz	Reg. No. 33,630
Leslie J. Paperner	Reg. No. 33,329

Address: **GREENBLUM & BERNSTEIN, P.L.C.**
1941 Roland Clarke Place
Reston, VA 20191

直接電話連絡先： Direct Telephone Calls to:

GREENBLUM & BERNSTEIN, P.L.C.
(703) 716-1191

唯一のまたは第一の発明者の氏名	Full name of sole or first inventor Yasuyuki ENDO
同発明者の署名 日付	Inventor's signature Date September 17, 2001
住所	Residence Kanagawa, Japan JPX
国籍	Citizenship Japan
郵便の宛先	Post Office Address Cosmo Chigasaki Belle Seine 2-47-303, Hibarigaoka, Chigasaki-shi, Kanagawa 253-0027, Japan
第二の共同発明者の氏名（該当する場合）	Full name of second joint inventor, if any
同第二共同発明者の署名 日付	Second Inventor's signature Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

（第三またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)